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SPEECH SOUNDS OF YOUNG CHILDREN

by

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FOREWORD

A class of liberal arts upperclassmen was asked recently to submit estimates of the average vocabulary of six-year-old children. The guesses ranged from 200 to 20,000! Popular ignorance of the appearance and development of speech sounds is certainly as great, and scientific knowledge of this highly important phenomenon has been conspicuously lacking.

The present study, while limited to 204 preschool children, is the first quantitative investigation to utilize 133 speech sounds in English and a reasonably adequate sampling of children. It presents in detail original and reliable techniques which lend themselves readily to the furtherance of research in this field.

Evidently learning proceeds rapidly. At three years the average preschool child (a high average child in the general population) gives correctly 83 per cent of the diphthongs, 75 per cent of the vowels, 68 per cent of the consonant elements, and 62 per cent of the consonant blends; while at five years these percentages all closely approach ninety. There is great variation in the difficulty of sounds—a finding of practical interest to parents and teachers, who are so often puzzled by children's failures on common words and phrases. Thus final sounds are more difficult than others.

The learning of speech sounds is not related to size of vocabulary nor to the number of older children in the family; it appears to depend primarily upon maturity as measured by chronological age.

While the findings reported here are of a preliminary nature, the authors have, with much skill and patience, definitely bridged the gap between previous fragmentary observations of speech sounds and the application of modern research methods.

GEORGE D. STODDARD.

Office of the Director
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SPEECH SOUNDS OF YOUNG CHILDREN

Statement of Problem

Development of language abilities and habits is a major activity of the preschool child. In the brief space of five years the child increases his spoken vocabulary from one word to approximately 2,500 words. That language and the building up of proper habits of speech play important roles in the life of the child is pointed out in the recent yearbook of the National Society for the Study of Education (28). Methods of enriching the child's language environment are discussed in that yearbook.

Despite the importance of the preschool period in building up habits of speech, little is known as to the degree of accuracy that may be expected in producing the different sounds of the English language. The material reported here represents a pioneer study in this field involving a large number of children. It includes a continuation and modification of the tests reported in Baldwin and Stecher's *The Psychology of the Preschool Child* (1), but with an added emphasis on what is normal speech development rather than on defective speech or remedial instruction. It forms a complement to the study of the extent of vocabulary and development of the sentence made by Smith (34) at the Iowa Child Welfare Research Station. Many of the same children were included in the two studies.

The purpose of this study was to determine the development of preschool children's ability to produce correctly the sounds of the English language. The specific aims were:

1. To develop a technique for the study of the young child's ability to produce sounds.
2. To establish tentative norms.
3. To study age, sex, and individual differences in producing speech sounds.
4. To study the interrelations of abilities on the different sound groups.
5. To study the relation of speech sound ability to other abilities and phases of growth.
6. To analyze errors.

The study was carried on with coöperation from the Department of Speech of the State University of Iowa, Sarah T. Barrows, assistant professor, advising on the technical aspects of speech. The data were mainly collected during the years 1925-1926 and 1926-1927 by Ida Mae Case, research assistant at the Iowa Child Welfare Research Station, supplemented by some preliminary data obtained by Nina Kenagy and Anna Cordts of the Department of Speech.

Previous Investigations of Speech Sounds

The development of the ability of young children to produce speech sounds has been the subject of very little investigation. Several persons have reported scattered observations on one infant or a small number of children under two years of age, but scarcely any material has been reported on the normal development of speech sounds in young children. Much more attention has been given to the study of vocabulary and to defective speech. A summary of investigations on all phases of language and speech development has been published in the recent yearbook of the National Society for the Study of Education, on Preschool and Parental Education (29).

Since the speech sounds of American preschool children are closely related to mastery of the English language, no attempt is made here to cover the literature in regard to other languages. Because of the different symbols and types of marking used and the inadequate description of method by the different investigators, it is almost impossible to tie together the scattered results heretofore obtained on specific sounds.

Observations on the speech sounds of one infant have been made by a number of persons who have included language ability in a more general study of the mental development of the child. Such observations were made as early as 1877 by Darwin (8), 1881 by Champneys (7), and 1885 by Perez (31); followed by Hall (16) 1896-1897, Moore (26) 1895-1897, Mickens (25) 1897-1898, Major (24) 1906, Dearborn (9) 1910, Bohn (6) 1914, Drummond (10) 1916, and Kenyères (20) 1927.

Tracy (40) 1895, made a careful analysis of the spoken vocabularies of several children, mostly under two years of age. The speech sounds of a number of infants during the

first thirty days of life were recorded and analyzed by Blanton (5). Fenton (11) in 1925 organized the published findings and presented original observations on her own child. Kuhlmann (22) included tests of spontaneous vocalization in his scale for the measurement of general intelligence. Gesell (13, 14) also included in his normative items ability to vocalize sounds.

Special studies of language ability, including particularly speech sounds of infants, have been made by Taine (39) 1877, Pollock (32) 1878, Humphreys (19) 1880, Hills (17) 1914, Bateman (2) 1915, Watson (41) 1925, and Holmes (18) 1927-1928. Foulke and Stinchfield (12) give the results of the study of speech sounds of four infants under two years of age. Only six articulate sounds were observed in seven days of observation of one child at seven months of age. In response to the Blanton-Stinchfield tests, one child at twenty-one months gave a total of thirty-one of the forty-eight sounds tested and another child at eighteen months gave thirty-one sounds. The development of the vocabulary from eight months to twenty-one months is traced and analyzed for one child, with changes by months in the pronunciation of thirty words.

Lukens (23) 1895-1896, discussed the mispronunciation of a child from two to four years of age. Morrison (27) 1914-1915, recorded the speech defects of 218 children five to seven years of age and instituted remedial instruction. Nice (30) 1915-1916, studied the speech of a left-handed child from the time she was three years, four months old until she was three years, nine months old. Baldwin and Stecher (1) 1925, presented two methods of studying speech ability of preschool children, but gave no results.

During twenty-four hours of continuous observation Gesell (13) found that 3 per cent of the waking time of a child six months of age was expended in some form of speech or language activity. Seventy-five sounds and combinations were used in 104 moments of vocalization. Hall (15) found sixty-three variations in vocal expressions before six months, forty of which were observed in one morning.

Imitation of sounds or words has been reported by Humphreys (19), Moore (26), Lukens (23), Mickens (25); Major

(24), Hills (17), Kuhlmann (22), and Gesell (13). Bohn (6) found that the infant under his observation expressed itself by means of sounds at the age of ten weeks; Drummond (10) reported specific sounds uttered to represent wants at the age of fifteen months.

Vowel sounds have been noted by a number of observers as appearing earlier than consonants. Taine (39) observed that during the first three and one-half months the cries and exclamations of the child included vowels only and that consonants were added gradually. Moore (26) found the first sound of one child to be a short expiratory *a*. Blanton (5) found that the birth cries of a number of infants ranged from simple *a* (as in at) to *u* (as in cut). Most of the cries were compound *u*, followed by *wah* (as in at) *uh* and *nga* (as in at). Differences in vowels and consonants were noted. Fenton (11) noted that among the baby's first sounds were a number of gutterals not used in English, the German *ch*, a harsh throaty *gh*, German *ö* and the French *en*. Tracy (40) found that vowels usually preceded the consonants; long before the sixth month the primitive vowels were combined with one another and with consonants, to produce the first syllabic utterances. Hall (16) noted that previous to fourteen months, terminal consonants were for the most part ignored. Difficulty in pronouncing words beginning with a vowel was avoided by preceding the vowel by the consonant that followed it. Moore (26) gave a list of the principal sounds and syllables noted in crying and in babbling by a child between the twelfth and fortieth weeks. Pollock (32) noted that at seventeen months final consonants were seldom or never given; at nineteen months *l* and final *t* and *p* were pronounced more or less distinctly; at twenty-three months palatals, dental aspirates, and short *a* were still imperfect. Hall (16) gives a table showing the day when each sound was introduced by a child during the first 500 days. She concluded that during the eighth to eleventh months more vowels than consonants were used; during the twelfth and thirteenth months as many consonants as vowels were used; and during the remainder of the time more consonants than vowels were used. Hills (17) who observed a child for ten days following the second birthday, found that imitation of vowels was almost perfect,

but that the child did not pronounce well or at all a considerable proportion of the consonants. Only nine initial consonants were used; the range of medial and final consonants was somewhat larger. Nice (30) reported that the speech of a left-handed child at three years four months, who was being taught to use her right hand, contained almost entirely vowels.

Holmes (18) observed no intervocalic consonants in the speech of a child up to eighteen months. A record was kept in the symbols of the International Phonetic Association. Final *k* was used, and *r* once only; final *t* and *d* were in the vacillating stage; no other final consonants were used. Initial *k* could be replaced by *t*. The liquids and *h* were not used. Hall (16) traced the development of sound through each month up to the twenty-fifth month, at which time the child possessed all of the English consonants except *l* and medial and final *f; s* was impure. Her most common error was vacillating between two consonants.

All of the sounds needed for language were present at the age of twelve months according to Taine (39), and at the close of the fourth month, according to Moore (26); Fenton (11) observed all of the English sounds except *f* and *v* during the first year, and Kenyères (20) observed that before two years all of the sounds in the French language were given correctly.

Moore (26) made the significant observation that although so many sounds were uttered with fluency during the month which preceded the acquiring of language not a word in the first vocabulary, with the exception of *mamma,* was phonetically in exact reproduction of the word copy. Humphreys (19) also found that, although at eleven months the child could imitate with accuracy any sound given her, when she dropped mimicry and acquired real words, she gave the ordinary infant pronunciations. Tracy (40) pointed out that sounds which afterwards give the child difficulty when he tries to produce them, are produced automatically before six months of age.

Moore (26) noted that sounds were frequently omitted, added, and substituted by a child twelve to forty weeks of age. Various substitutes were used for each sound. Lukens (23) found that a child's normal mispronunciation from two

to four years of age was an indistinctness or vagueness rather than a substitution of a wrong sound for a right one. He gave a table of mispronounced initial sounds for several children from twelve to forty-five months of age. The sounds *t* and *h* were substituted for many other sounds.

Kirkpatrick (21) gives three causes of mispronunciation: (1) difficulty of combinations even when the component sounds are separately easy, (2) modification by preceding and succeeding sounds, and (3) mispronunciation or careless pronunciation by adults whom the child hears. Perez (31) makes the following comments on mispronunciation: (1) The accented syllable is commonly reproduced. (2) Initial and final sounds have the advantage over the middle sounds in competition. (3) Lingual facility of the sound combination is a factor. (4) Length and form are reproduced even where separate sounds are not correct. (5) Consonants are sometimes introduced to aid in pronouncing initial vowels.

Seven hundred instances of mispronunciation of several children approximately two years of age were analyzed by Tracy (40), who gives a table showing the number of times each sound was replaced by another sound, the number of times it was dropped but not replaced, and the number of times interpolated, according to initial, medial, or final positions. Mispronunciation was frequent in the case of double consonants. Choice of a substitute for a difficult sound was often determined by the prominent consonant in the preceding or succeeding syllable. This led to a duplication of the easier sound in preference to the use of the more difficult one, as in *kawkee* for coffee, *kork* for fork. The number of these duplications was large and the device was adopted in the case of difficult vowels, e.g., *Dida* for Ida.

Forty-nine per cent of the 218 children, five to seven years of age, tested by Morrison (27) gave *th* incorrectly but only 12.8 per cent showed other marked defects of articulation. Incorrect habits were found most often in *ch* as in chair, *k* or hard *c*, *l*, *r*, *s*, and *sh*. The number of incorrect sounds ranged from one to ten for any child. Morrison's method was to elicit through pictures spontaneous responses containing the desired sounds. Practically none of the sounds was corrected from hearing a correct sample. Instruction for three

weeks, however, resulted in all but four of twenty-eight children being able to give the sounds correctly.

Method and Procedure of Testing Speech Sounds

The method used in this study was the testing of the child's ability to produce the sounds of the English language by securing verbal responses through questions and the presentation of pictures and toys. The questions were organized in such a way that the answers would contain certain words not used by the examiner. The sounds used by the child in these words were recorded in phonetic symbols. The method was adapted to meet the following requirements:

1. To elicit spontaneous speech, without a word pattern or model.
2. To permit indirect guidance of the child's response.
3. To provide situations for testing the sounds in their various positions.
4. To make possible testing of all the sounds within a comparatively short period.
5. To give all children an equal opportunity to produce the different sounds.
6. To record the speech responses of the child in such a manner that the interpretation would be indisputable.

A record of the child's speech during his daily activities would be a valuable supplement to the testing method, but was not considered practicable for purposes of this investigation because of the length of the observation that is necessary with such a method in order to obtain each sound in the various positions, and the difficulty of obtaining for quiet children a record of all sounds.

In the preliminary study the materials used were toys which ordinarily bring an active response from young children. The examiner handed one toy at a time to the child, recorded his comments, and asked questions about each toy. The toys used, types of questions asked, words desired, and sounds desired were:

Questions and Actions	Toy	Word Desired	Sound Desired
1. What is this? What does he do? What does he say?	cow	cow, moo, gives milk	k–, aU, m–, u, g–, I , –lk
	horse	horse, run	h–, ɔ:, –n
	pig	pig, wee-wee	p–, –g, w–, i
	lamb	lamb, baa, Sheep, baa	l–, æ, –m, b–, ʃ–, –p
	cat	cat, miau, scratches	–t, skr–, –tʃ–
	dog	dog, bow-bow, barks	d–, ɔ, a, –ks
	turkey	turkey, gobbles	t–, ə, –r–, –k–, –b–, lz
	hen	hen, squawks	ɛ, skw
	rooster	*rooster, crows*	r–, kr–
	bear	bear	ɛ:, –r
2. What does he do? (Standing animals up, letting them fall)		stand up, fall down, swim, splash, with	st–, nd, ʌ, f–, –l spl–, –ð,
3. What does he eat? What does he drink?		drink, milk, water, straw, corn, oats, meat, grass, bones, hay, honey, mice, vegetables	dr–, ŋk, –t–, str–, o, –ts, gr–, a, nz, e, –n–, aI, –s, v–, –dʒ–
4. Naming colors of animals		brown, black, white, red, gray, yellow	br–, bl–, –k, –d, j–, ʍ,
5. Naming parts of animals		head, tail, feet paws, horns, mouth, claws, wool, comb, feathers, whiskers	–z, –ɵ, kl–,
6. Talking about other toys while playing with them	dishes and stoves	dishes, cups, cup, saucers, plate, stove, skillet, frying pan, spoon, little measuring cup, put the dishes away, match, these	–ps, –ʃ–, pl, –v, sk–, –l–, fr–, –ŋ, –p–, –s–, –v–, ð–, ə, –w–, –ʃ–, sp–, tl, ʒ, –tʃ, ɵ–, ŋz, –dʒ, –f–,

	things, coffee pot, edge, (counting toy silver), three, twelve, something	ər–, –lv, tw–, –ə–
dolls, dolls' clothes	another one, old, new, put on, take off, boy, girl, legs, heads, arms, buggy, finger, bib, mama, pretty, gloves, quiet, snap, body, dance	–ð–, –ld, n–, ju, –f, ɔI, –gz, –dz, –mz, –g–, ns, ŋg, –b, gl–, –m–, pr–, –d–, kw, sn–
jumping-jack	jumping-jack, open, shut, lid, push, easy, self, spring, can't, won't	mp, dʒ–, U, –ʃ, –z–, lf, spr, –nt, s–,
train	train, engine, flat car, bell, ringing, smoke, switch, slow, choo-choo, fast, union station	tr–, –ŋ–, –dz–, fl, sm, sw–, sl–, tʃ–, –st, –j–

In the main investigation, pictures were substituted for the toys, but otherwise the method remained substantially the same. The chief reasons for the introduction of pictures were that more objects could be shown within a given time, the children were more passive when looking at pictures and responded better to suggestions than when absorbed in the occupation of playing with the toys, and it was thus easier to direct the conversation to test all sounds. It took more time and tact to direct children into activities with the toys because they were more likely to initiate irrelevant activities or to persist in a given activity for a longer period. With two-year-old children or shy children, however, toys seemed better adapted for initial use, helping to produce a feeling of friendliness with the examiner so that following interviews were more successful. The advantage of either material depends somewhat upon the skill of the examiner in establishing rapport and in directing activities and responses.

The pictures used were cut from magazines and mounted on cards six by nine inches. The set included sixteen cards.

The conversation during the examination was somewhat elastic, depending upon the response of the child tested. If the desired response was not obtained from the first stimulus, more stimuli were given; as soon as it was obtained, no further attempt was made to secure that sound. If the sound was not brought out in any of the responses, it was left to another period of testing.

Talkative children seldom needed more than the stimulus of picture or toy. Some children who did not respond to direct questions were engaged in indirect conversation such as about things the pictures suggested or things of interest in the play room.

The following tabulation gives a list of words or phrases that might be elicited in response to each picture, possible sounds desired, and some suggested questions and conversation:

Picture	Words and Phrases Desired	Sounds Desired	Suggested Conversation and Questions
1. Baby asleep in baby carriage on lawn	baby buggy sleeping grass wheels	b–, –b–, ʌ, –g–, –p–, sl, i, gr, a, ʍ–, i, lz	What is the baby doing? What is the baby in? What is the baby doing in the buggy? What is on the ground? What are these? (pointing to the wheels)
2. White rabbit	rabbit white bunnie pink	–b–, r–, æ ʍ–, –t, –n– p–, ŋk	What is this? What color is the rabbit? Have you seen a white rabbit? Look at his long ears. What color are his ears?
3. Two tubs	tub wash something washing	t–, –b, w–, –ʃ –ɵ–, –ʃ–	What is this? Can you wash clothes in the tub? Is there something in the tub or nothing? What is in the tub?

4. Clothes on clothes line	pins clothes	I, nz, kl–, o	What is hanging on the line? What do you hang clothes up with? How do you hang up clothes?
5. Colored broom	broom yellow sweep scrub	br–, –m, u, j–, –l–, sw–, –p, skr, –b	What is this? What color is the broom? What do you do with the broom? We have a broom in preschool. What do you do when you spill the sand?
6. Pail	pail	p–, –l	What is this? That is what we carry water in. It has a handle. You tell me what it is.
7-11. Two dolls, a dog, bear, and boy	dog, doll, dolls, boy bear, black bow-bow pretty, that, this	d–, ɔ, –g, –l, lz, ɔI, ɛ:, –r, bl, æ, –k, –w–, pr, –t–, –t, ð–	What is this? This? etc. What color is the bear? What does the dog say? Is that an ugly or a pretty doll? Which doll do you like the best? This one or that one?
12. A collie dog with six puppies, and another dog with a loaf of bread in his mouth trying to get through the fence to them	puppies dogs little six seven four, five eight eleven brown, black bow-bow this, that mother father something mouth fence	p–, –p–, ʌ, d–, gz, l–, tl, I, s–, I, –ks, –v–, –n, ɛ, f–, –r, –v, aI, e, –t, –v–, –l–, br, aU, bl, –w–, ð–, –s, m–, –ð–, –ð–, ɑ, –ɵ–, –ɵ, aU, f–, ɛ, –ns,	What do you see in this picture? There is a mother dog and her little puppies. Is this a big dog or a little dog? How many puppies has the mother dog? You count them. You count them with me, 1, 2, 3, 4, 5, 6. How many puppies? Let us count all the dogs. What color is this pup? What does the dog say? Which one would you like to have? This one

			or that one? These are the baby dogs. What is this? This is the mother. Who is this? Does he have something or nothing in his mouth? Where is the bread he wants to give the puppies? Why can't he go to the puppies? Do you know what this is? That is a fence.
13-18. Duck, egg, kite, cow, goat, hat	hat, duck, egg, kite, cow, goat	-k, h, æ, k-, -t, -g, g-,	Tell me what these are.
19. Little girl getting into bathtub	bath	b-, -θ,	What is this little girl going to do? What is she going to get into? What is in the tub? She is going to wash with a sponge. Can you find the sponge?
	tub	t-, -b,	
	water	w, -t-,	
	stockings	st-, -k-, ŋz,	What did the little girl take off before she stepped in the water? What did the little girl put on the floor? Those are her stockings. What are these (pointing to shoes)? What else is on the floor? Can you take a bath by yourself? Do you have to have help? What happens to the water when you hit it?
	shoes	ʃ-, u, z,	
	rug	r, -g,	
	myself	s-, lf,	
	help	h, -lp,	
	splashes	spl, -ʃ-,	
20. Baby with thumb in mouth	baby	b-, -b-,	What does the baby have in its mouth? You don't put your thumb in your mouth,
	thumb	θ-, ʌ, -m,	
	my thumb	-θ-,	
	finger	ŋg,	

			do you? What is this. (taking hold of child's thumb)? Is this your thumb or my thumb? How many thumbs do you have? Show them to me. What are they?
21. Feather	feather	–ð–,	What is this? That is a feather. What do birds have? The birds have feathers. What do chickens have?
22-27.			
Lamb, moon, wagon, lantern, hand, hammer	lamb, moon wagon lantern hand hammer	l–, –m, m–, u, –n, w–, –g–, ə, h, nd, –m–, ə,	What is this? And this, etc.
28. Child on doorstep eating a doughnut, birds all around him	eating a doughnut with sugar	–t–, –ŋ, d–, o, –n–, –ð, ʃ–, U, –g–,	What is the little boy doing? He is eating a doughnut. Do you like doughnuts? With or without sugar? What is the boy eating? Who
	birds crumbs	b–, ə, dz, kr, mz,	is waiting for the crumbs? What are these flying about the boy? What would happen if you scared
	fly away wings	fl, –w–, ə, w–, I, ŋz,	the birds? What would they fly with? Here's a bird flying. What are those she had spread out? See the birdie's wings (pointing)? What are these (pointing to another bird)? This bird is flying away. Is he afraid
	scared tweet	sk, tw,	or scared? What does the bird say?
29. Trees and green grass	green, grass trees	gr, tr, i,	What color is the grass? It is green.

			What color are the trees?
30. House with smoke coming out of the chimney	house smoke	h, aU, –s, sm,	What is this? Can you see something coming out of the chimney? What is it?
31. Bird perched in tree looking at nest of eggs	nest eggs	n–, –st, ɛ, –gz,	Oh, what does the bird have? What is in the nest?
32. Cartoon of tailors trying to convince a man that vest and trousers which do not meet are a "perfect" fit	men measure vest	m–, –ʒ– v–, –st,	Look at this funny picture! Here's a funny man. What are these (funny men)? This man has a tape measure. What are they doing? This man is measuring his vest. See, this funny man has a short vest. It doesn't fit him. What is this man going to do with his measuring stick?
33. Illustration of how to take chest measurement	measure	–ʒ–,	This man has a measuring tape around him. What does this man have?
34. Lady	lady	–d–,	Is this a lady or a man?
35-39. Fan, fish picket fence scissors knife	fan, fish fence scissors knife	f–, –ʃ, –n, f–, –ns, s–, –z–, n–, –f,	What is this? etc.
40. Vase	vase	v–,	What is this? That is what you put flowers in—a vase. What do we put flowers in?

41. Man in shirt sleeves with vest on	vest	v–, –st,	What does this man have on? A vest. What does your daddy wear under his coat?
42. Older girl helping younger boy to brush teeth	brush brushing tooth teeth mouth tongue	br, –ʃ, –ʃ–, t–, –ɵ, m–, –ɵ, –ŋ,	What are they doing to the baby's teeth? The baby is having his teeth brushed. What is this (tooth brush)? Do you brush your teeth? Let's see your teeth. That is good. Let's see how far you can put out your tongue. Like this. Now put your tongue way back. What did you show me?
43. Two watches	watch watches one three four five six seven eight twelve count	w–, –tʃ, –tʃ, w–, –n, ɵr, f–, –r, –v, s–, ks, –v–, –t, tw–, –nt,	What is this? Can you count the numbers? You count them with me (one to twelve). How many numbers?
44. Pitcher of milk	pitcher milk	p–, –tʃ–, lk,	What is this? What does it have in it?
45. Dish of peaches	peaches	–tʃ–, –z,	Here is something good to eat. What are they?
46. Hatchet	hatchet	–tʃ–,	This is something you chop with. What is it?
47. Shoes	shoes	ʃ–, u, –z,	What are these? What are these (touching the child's shoes)?

48. Train	train	tr–, e, –n,	What is this? What does the train run on? What do you call the front part of the train? What is this? What is coming out of the chimney? Can you be the engine? Choo Choo! You be the engine.
	track	tr–,	
	engine	–dʒ–,	
	smoke	sm, o, –k,	
	choo	tʃ–,	
49. Baby with glass of orange juice sitting in high chair	chair	tʃ–,	What are you sitting in? Are you sitting in a big chair or a little chair? What is the baby sitting in? She is going to drink something you drink. What is it? It is made out of oranges. What did you do with your orange juice today? What would happen if you tipped the cup?
	drinking	dr, ŋk,	
	orange	ɔ, –r–, –dʒ,	
	oranges	–dʒ–,	
	spill	sp,	
	spilled	ld,	
50. Oranges	oranges	–dʒ–,	What are these?
51. Cow jumping over the moon	jump	dʒ–, mp,	Oh, what a funny cow! What is she doing? (Tell "Hi Diddle Diddle.") What did the cow do? The cow jumped over the moon. Can you jump? Let me see you jump. What did you do?
52-53. Jug, jar	jug, jar	dʒ–,	What is this?
54. Bear in a cage	bear	b–,	What is the bear in? He can't get out. He is in a cage. Where is the bear?
	cage	k–, –dʒ,	
	can't	–nt	
55. Little girl laughing	laughing	l–, –f–,	What is the little girl doing? She is laughing. What is

as she tries to catch falling leaves			she doing? Ho! Ho! Ho! What am I doing? The little girl thinks it is fun to catch the leaves. The wind is blowing them from the trees. What is falling on the ground? What is the little girl trying to catch?
	leaves	l–,	
	leaf	–f,	
56-61.			
Rake, rope	rake, rope	r–, e, –k, –p,	What is this? etc.
truck	truck	tr,	
umbrella	umbrella	–l–,	
aeroplane	parasol	–r–, –l,	
gloves	aeroplane	pl,	
	gloves	gl,	
62. Girl pulling a sled on which a little boy is sitting It is snowing	riding	–d–,	Here is a little girl giving her brother a ride.
	sled	sl,	
	green	gr,	
	red	r–, ɛ,	What is the little boy riding on? Do you have a sled? What color is the sled? What color is the little boy's suit? What does he have around his neck? A red and white scarf. What does the little girl have around her neck? What does she have on her head? What is the little girl doing? What is the little boy doing? What is coming down from the sky? What is the white on the ground? It is snowing. What is on the ground? Where is the snow coming from? What have
	scarf	sk, –f,	
	cap	k–, –p,	
	snow	sn, o,	
	sky	sk,	

			you seen in the sky? The moon? What else? Have you seen stars?
	stars	st, ɑ,	
63. A number of zebras drinking at a pool	zebras	z–,	What are these? Those are zebras. They are drinking. What is this? A zebra. He looks like a pony, but he has some stripes on him. That isn't a horse—what is it?
64. Roller skates	skates	sk, e, –ts,	What are these? Skates. Do you have skates? What do you do with skates?
65. Boy and girl swinging	swinging	sw, –ŋ–,	What are the boy and girl doing? They are sitting in a swing. What are they doing in a swing? What do you do in a swing? What do you wear—pants or a dress? What is this girl wearing? What color is her dress? What is the boy wearing? Does he have on pants or a dress?
	dress	dr, –s,	
	blue	bl–, u,	
66. One boy on a tricycle, another standing behind him with his hands on the bars	tricycle	tr–, –s–, kl,	What do these two boys have? What is this boy doing? What is this boy doing? They got a tricycle for Christmas.
	riding	–d–,	
	pushing	–ʃ–,	
67. Boy with a drum	drum	dr, –m,	What did this boy get? What is he doing to the drum?
	beating	–t–,	

68. Little girl playing in a garden	yard fence play	j–, –d, –ns, pl,	Here is a little girl playing. Where is she playing? In a yard. What is the little girl doing in the yard? What is this around the yard?
69. Ball	ball play throw	–l, pl, or,	What can you do with a ball? Can you throw it? Do you have a ball? What do you do with it?
70. Onion	onion	–j–,	What is this? That is an onion. We like onions. Do you eat onions? This is a picture of what?
71. Doughnuts	doughnuts sugar	d–, o, –n–, –ts, ʃ–, U, –g–,	What are these? Doughnuts. Do you like them with sugar or without? With or without?
72. A cake with a piece cut out and on a small plate, and a cake knife	cake frosting knife with	k–, –k, fr– n–, –f, –ð,	Do you like cake? What does the cake have on it? Frosting. What does this piece have on it? Do you like cake with or without frosting? What do you cut a cake with?
73. A quart bottle of milk	milk bottle quart drink	m–, –lk, tl, kw, dr, –ŋk,	Here is something good to drink. What is it? What is the milk in? Yes, in a quart bottle. Do you know how much milk is in the bottle? How much could you drink? A quart?

74. Vase	vase	v–,	Here is something we put flowers in. What is it? A vase. What do you put flowers in?
75. A box of strawberries	strawberries red	str, ɔ:, r–, –d,	Oh, here are some berries. What kind of berries? Do you like strawberries? What are these? What color are they?
76. Spoons	spoons	sp–, u, –nz,	Here is something we eat with. What are they?
77. Spool of thread	spool	sp, u,	What is this?
78. Gas stove	stove	st–, –v,	What does your mother cook on? Doesn't she have a stove? What is this?
79. Cups	cups drink milk	k, ʌ, ps, dr, lk,	What are these? What is this part of the cup? What do we do with cups? Do you drink orange juice? What else do you do (drink milk or water)?
80. Little boy sitting with a fish pole in his hand and crying because the fish don't bite. A kewpie is swimming around	crying fish stick string cap kewpie	kr–, aI, –ŋ f–, –ʃ, st–, str–, –ŋ, k–, æ, –p, ju, –p–,	Oh, there are tears in the little boy's eyes. What is he doing? He is crying because he can't catch any fish. What does he have in his hand? What has he tied to the stick? What does the boy have on his head? Who is this? This

	after one of the fish and a frog is jumping to get out of his way	catch frog swimming	-tʃ, fr-, sw-, -m-,	is a kewpie. Who is this? What is the kewpie trying to do? What is this jumping at us? A frog. What is it?
81.	Little girl standing on steps at lavatory holding toothbrush under faucet	wash brush steps	-ʃ, br, -ʃ st-, -ps,	What is the little girl doing? What is she standing on? She climbed up the steps, one, two steps. What are these?
82.	Combs	combs	mz,	What are these? What do you comb your hair with?
83.	Santa Claus in his sleigh pulled by reindeer	Santa Claus, sled, sleigh reindeer	s-, -nt, kl, sl, r,	You know who this is. Who is in the sleigh with a pack of toys? What is Santa driving?
84.	A little girl and an elf, each with a sprinkling can. Another sprinkling can	sprinkle sprinkling flowers elf	spr, ŋk, fl, aU, lf,	What does the little girl have? A *sprinkling* can. What is she going to do with the sprinkling can? Sprinkle flowers. Here is a little elf. What does he have? A sprinkling can. What is this?
85.	Girl with a basket of grain feeding chickens	girl basket chickens feeding feeds white corn red feet scratch	g-, b-, tʃ-, I, -k-, nz, f-, i, -d-, dz, ʍ-, aI, -t, k-, -n, r, f-, i, skr, -tʃ,	What do you see in this picture? What is the girl doing? What is she carrying the feed in? The girl has a basket. What do you think is in the basket? What color are the chickens? What color is

			this? What are these? What do the chickens do in the dirt with their feet? They scratch. What am I doing (making motion of scratching)?
86. One boy in bathtub, splashing water on another boy standing near	splashing water bathtub	spl, –ʃ–, w–, –t–, ə, –ɵ, t–, ʌ, –b	What is the boy doing in the water? He is splashing the water. What do you do when you hit the water? Where is the boy?
87-92.			
Flower candle lamp, apple, kettle, saw	flower candle lamp, apple kettle, saw	fl–, aʊ, ə, l–, æ, mp, pl, tl, s–, ɔ:,	Name these pictures.
93. Clock	clock three seven twelve	kl, ɔ, –k, ɵr, –v–, tw, lv,	What is this? Let's count the numbers. How many?
94. Pyrex dish of twelve raisin cookies	cookies raisins glass	k–, ʊ, –k–, –z, r–, e, –z–, nz, gl–,	What are these? What do the cookies have in them? Count the cookies. Are they in a tin pan or a glass pan? Do you drink out of a glass or cup? What is the window made of?
95. Quilt	quilt	kw,	What is this?
96. Two yellow ducklings	ducks quack yellow orange swim	d–, ʌ, ks, kw, j–, ɛ, –l–, o, –dʒ, sw–, –m,	What are these? What color are they? What color are these feet? What do the ducks say? Quack! You be a duck. What do the ducks do?
97. Squirrel	squirrel	skw, –r–, –l,	What is this? What

	with a nut	nut	n–, –t,	is he going to eat? Have you seen a squirrel? Who is going to eat the nut?
98.	Rough drawing of a house	you	ju,	Does this belong to you or to me (holding up a pencil)?
		yours	j–,	This is mine. Is it yours or mine? You may use it. What is that (drawing a square)? A square.
		square	skw–,	What is that (drawing another square)? Now you make a house like this one.
		straight	str–	Is this a straight or a crooked line (drawing a broken and a straight line)?

As the child spoke, his phrases or words were transcribed into sounds of the phonetic alphabet. The symbols of the International Phonetic Association were used. Each sound was represented by a separate symbol. The advantage of this system over the dictionary diacritical systems is that only one interpretation of a symbol is possible. The symbols were as follows:

Consonants

p	pie	(paI)	ɵ	thin	(ɵIn)
b	be	(bi)	ð	they	(ðe)
t	tea	(ti)	s	see	(si)
d	do	(du)	z	nose	(noz)
k	key	(ki)	ʃ	she	(ʃi)
g	go	(go)	ʒ	pleasure	(plɛʒəɹ)
m	me	(mi)	tʃ	chair	(tʃɛːɹ)
n	no	(no)	dʒ	jay	(dʒe)
ŋ	sing	(sIŋ)	l	lay	(le)
ʍ	when	(ʍɛn)	r	row	(ro)
w	we	(wi)	ɹ	hard	(hɑɹd)
f	fee	(fi)	j	you	(juː)
v	vie	(vaɪ)	h	hay	(he)

Vowels

i	free	(fri)	u	true	(tru)
I	sit	(sIt)	U	bush	(bUʃ)
e	late	(let)	o	note	(not)

ɛ	get	(gɛt)	ɔ:	law	(lɔ:)
ɛ:	there	(ðɛ:ɹ)	ɔ	long	(lɔŋ)
æ	hat	(hæt)	ɒ	bird	(bɒɹd)
ɑ	car	(kɑɹ)	ʌ	but	(bʌt)
			ə	about	(əbɑUt)

Diphthongs

aI	ride	(raId)	ɔI	boy	(bɔI)
ɑU	house	(hɑUs)	ju	cute	(kjut)

The position of the sound in a word was indicated by dashes. If the sound came in the initial position, as *v* in vase, the dash was placed after the letter (*v*–); if it came in the medial position, as *v* in river, a dash was placed each side of the letter (–*v*–); and if the sound came in the final position, as *v* in five, the dash was placed before the letter (–*v*). If a consonant appeared in different positions, it was treated in this study as a separate sound in each position.

The number of sounds tested was 133, including 66 consonant elements, 48 consonant blends, 15 vowels, and 4 diphthongs.

The examiners were graduate students majoring in speech, who had had considerable training in phonetics and experience with children. One examiner gathered practically all of the data used in this report.

The subjects were 204 children from two to six years of age, who were in daily attendance in the preschool laboratories of the Iowa Child Welfare Research Station. The average intelligence quotient on the Stanford revision of the Binet scale was 115.9, with a standard deviation of 15.4. Each child was taken to an individual examining room and was usually kept there from six to ten minutes. The number of interviews depended upon the response and success in obtaining the sounds to be tested. The complete time for each child varied from fourteen to eighty minutes. The average time was longer for the younger children than for the older ones.

Although it was desired to obtain a complete record on all sounds for every child, it proved difficult to obtain records on certain sounds for some children because of their failure to give the words desired. In such cases the sounds involved in the desired words were considered as not tested.

Several forces probably operated to increase the number of non-tested sounds: (1) greater difficulty of some sounds, and hence failure of some children even to attempt them, (2) smaller frequency of these sounds in the children's vocabularies, (3) insufficient time on the part of the examiner, and (4) faulty technique of the test in attempting to elicit from a given child words not a part of his vocabulary, although known to other children. For purposes of analysis the children have been divided into three groups:

1. Group A, including all children and all of the 133 sounds. The number of children tested on the separate consonant elements ranged from 72 to 204, on consonant blends from 144 to 196, on vowels from 46 to 202, and on diphthongs from 180 to 198.
2. Group B, including only those children who were tested on every sound within a given sound group. A few sounds were omitted from consideration because of the small number of children for whom results were recorded, reducing the total number of sounds to 123. One hundred twenty children were tested on all of 61 consonant elements, 65 children on 47 consonant blends, 113 children on 11 vowels, and 113 children on 4 diphthongs.
3. Group C, including 57 children who were completely tested on the 123 sounds.

Reliability of the Test, Age and Sex Differences

Reliability

Reliability of the test was determined by correlating halves composed of alternate sounds on the record blank. The number of odd sounds given correctly was correlated with the number of even sounds given correctly for the fifty-seven children from two to six years of age for whom there was complete information on 123 sounds. One sound was dropped in order to provide equal halves. The order of listing sounds on the record blank is given on pages 29-30. The range of sounds given correctly was from nine to sixty-one on a half-test. The correlation obtained was .96±.01, indicating a high degree of reliability.

Correlations were also obtained for alternate consonant elements for two age groups of children who were completely tested on sixty-one consonant elements. The range of sounds given correctly was from twelve to thirty on a half-test for thirty-four four-year-old children, and the correlation was .77±.05; for thirty-six five-year-old children the range of items

was from twenty-two to thirty and the correlation was .80±.04.

From the standpoint of reliability alone, it would have been desirable had the test been completely repeated on the same children after an interval of only a few days. This would have enabled a better check on the consistency of the examiner in detecting sounds, the consistency of the child in producing sounds, and the consistency of the test method in securing results, but it would not have been possible with the method used to separate their relative contributions. Because it would have doubled the time required, however, it did not seem feasible in this investigation. Some measure of the child's consistency was obtained for those sounds that occurred several times during the test; this will be discussed in a later section of this report concerning substitutions, omissions, and inconsistencies of response.

TABLE 1

Mean, Standard Deviation, and Per Cent of Sounds Correct according to age

Group B					Group C				
Age, Years	Number of Children	Children Completely Tested on One Sound Group			Age, Years	Number of Children	Children Completely Tested on Four Sound Groups		
		Mean	S.D.	Per Cent Correct			Mean	S.D.	Per Cent Correct
61 Consonant Elements									
2	10	24.3	9.6	39.8	2	6	24.0	7.1	39.3
3	28	41.7	11.1	68.4	3	16	43.2	9.6	70.8
4	35	47.4	11.1	77.7	4	15	46.3	8.0	75.9
5	36	54.2	4.4	88.9	5	18	54.7	4.5	89.7
6	11	53.1	8.1	87.8	6	2	60.5	.5	99.2
47 Consonant Blends									
2	7	5.1	9.1	10.9	2	6	5.8	9.4	12.3
3	17	24.3	11.8	51.8	3	16	25.4	11.5	55.4
4	17	34.4	7.3	73.2	4	15	33.6	7.7	71.5
5	21	40.9	6.4	87.2	5	18	40.8	6.3	86.8
6	4	43.0	3.5	91.5	6	2	46.5	.5	98.9
11 Vowels									
2	8	7.5	1.58	68.2	2	6	7.3	1.10	66.4
3	26	8.3	1.74	75.2	3	16	8.5	1.82	77.3
4	28	8.8	1.49	80.2	4	15	9.1	1.44	82.7
5	37	9.8	1.42	88.9	5	18	9.9	2.01	90.0
6	14	9.5	1.49	86.4	6	2	11.0	0.00	100.0
4 Diphthongs									
2	8	2.3	.88	57.5	2	6	2.3	1.25	57.5
3	21	3.3	.94	82.5	3	16	3.2	.70	80.0
4	37	3.5	.76	87.5	4	15	3.4	.73	85.0
5	36	3.6	.83	90.0	5	18	3.5	.48	87.5
6	11	3.7	.45	92.5	6	2	4.0	0.00	100.0

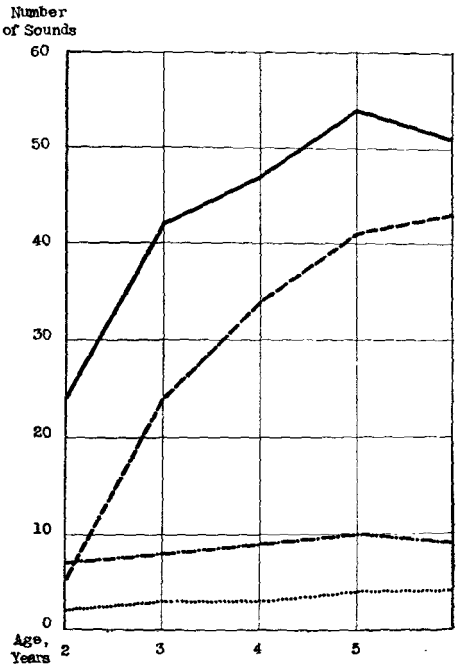

Figure 1. Mean number of sounds given correctly by age groups

———— Consonant elements (61)
— — — — Consonant blends (47)
—.—.—.—.—. Vowels (11)
. . . . . Diphthongs (4)

It would also have been desirable had the separate sittings for any one child been more closely grouped together than they were in this investigation, avoiding the changes in speech ability due to the intervening development of the child. For some children the interviews were spread over a period of two months.

Age Differences

The mean number of sounds given correctly by age groups,

with the standard deviations is given in Table I. An age group includes children from six months past a given year to the next year, five months, and twenty-nine days. Such division places the birthday in the center of the distribution. The increase from year to year for children in Group B is also illustrated in Figure 1. The mean number of consonant elements given correctly by the twenty-eight children at three years of age in Group B was almost twice the number given correctly by the ten children at two years of age. From then on, the increase was less abrupt from one age to the next, but there was a steady rise except from five to six years where the slight drop may be accounted for by the small number and selection of cases at six years.

Of forty-seven consonant blends only 5.1 were given correctly by the seven children who were two years of age, but nearly five times this number were given correctly by the seventeen children who were three years of age. From three years on there was a steady increase from year to year, as will be seen in Figure 1. Of eleven vowels on which 113 children were completely tested, 7.5 were given correctly by the eight children at two years, the number then increasing gradually from three years to five years. Of four diphthongs on which 113 children were completely tested, 2.3 were given correctly at two years and 3.7 at six years.

For Group C the fifty-seven children who were completely tested on all four sound groups, the means were practically the same as for Group B. The only notable exception was for the two six-year-old children of Group C, who were superior in their speech accomplishments. The mean total number of sounds given by Group C was 39.7 at two years, 79.8 at three years, 92.5 at four years, 108.4 at five years, and 121.0 at six years. The standard deviations were 18.99, 21.93, 13.36, 10.86, and 1.00, respectively.

In order to determine whether the differences in the means represented true age differences, the ratios of the differences to the standard deviations of the differences were computed. A ratio of 3.0 or more was taken to indicate a true difference greater than zero. Excluding the six year group because of the small number of children and selection, the

ratios for consonant elements for Group B were above 3.0 in every comparison except between three and four years, where the ratio was 2.01. For consonant blends, excluding the six year group, the ratios ranged from 2.86 to 9.66. For these two sound groups, then, there were significant differences in the number of sounds given correctly. For vowels, the ratios between any age group and a year older were all below 3.0, the ratios showing a tendency to increase, however, with age. The ratios indicated that for vowels a true difference greater than zero existed between the five year group and the two year group and between the five and three year group, and that a true difference was closely approached between the five year group and the four year group. For diphthongs, the ratios indicated that a true difference greater than zero existed between the two year group and the four year group and between the two year group and the five year group, and that a true difference was closely approached between the two year group and the three year group (Table 2).

For Group C the ratios followed much the same trend as for Group B, but varied somewhat because of the smaller number of children.

In Table 1 are also given the percentages of sounds correct. Group B children at two years of age gave 68.2 per cent of the vowels correctly, 57.5 per cent of the diphthongs, 39.8 per cent of the consonant elements, and only 10.9 per cent of the consonant blends. At three years the differences are less marked, the percentages being 82.5 for diphthongs, 75.2 for vowels, 68.4 for consonant elements, and 51.8 for consonant blends. At five years the sound groups are about equalized, the percentages varying only from 87.2 to 90.0. The percentages for Group C children are practically the same as those for Group B. At two years of age approximately 32 per cent of the total number of sounds were given correctly, at three years 63 per cent, at four years 77 per cent, at five years 88 per cent, and at six years 89 per cent.

Further data at the two year level are needed to determine whether the abrupt rise from two to three years in

TABLE 2

Age Differences in Number of Sounds Correct. Ratio of Differences in Means to Standard Deviations of Differences.

Age, Years	Group B: Children Completely Tested on One Sound Group — Age, Years				Group C: Children Completely Tested on Four Sound Groups — Age, Years			
	3	4	5	6	3	4	5	6
Consonant Elements								
2	4.68	6.47	9.23	7.38	6.26	9.91	5.09	12.10
3		2.01	5.57	3.53		.98	4.38	7.13
4			3.38	1.85			3.63	6.77
				-.44				5.18
Consonant Blends								
2	4.31	7.89	9.66	9.77	2.35	4.71	4.75	12.71
3		3.13	5.46	5.55		2.34	4.75	6.21
4			2.86	3.43			2.90	6.39
5				.94				3.80
Vowels								
2	1.18	2.10	3.80	2.91	1.87	3.10	3.50	8.14
3		1.24	3.65	2.34		1.03	2.15	5.55
4			2.63	1.40			1.33	5.13
5				-.61				2.34
Diphthongs								
2	2.56	3.73	3.84	4.24	1.20	4.45	1.95	3.33
3		1.19	1.39	1.92		2.47	4.61	1.44
4			.50	1.03			1.54	1.10
5				.50				1.40

the curves shown in Figure 2 for percentages of sounds correct will be substantiated, and also to determine whether the marked differences between the sound groups at two years represent typical differences.

In Table 3 is given the number of sounds produced correctly by the different percentages of children by age groups. There was a wide variability in the difficulty of different consonant elements for two-year-old children, as evidenced by the wide spread from sounds that no child gave correctly to the one sound that all gave correctly. Thirteen consonant elements were given correctly by less than 10 per cent of the two-year-old children, and thirty-two of the sixty-six consonant elements were given correctly by less than 30 per cent of this age group. From three years on, at least 30 per cent of the children gave each consonant element cor-

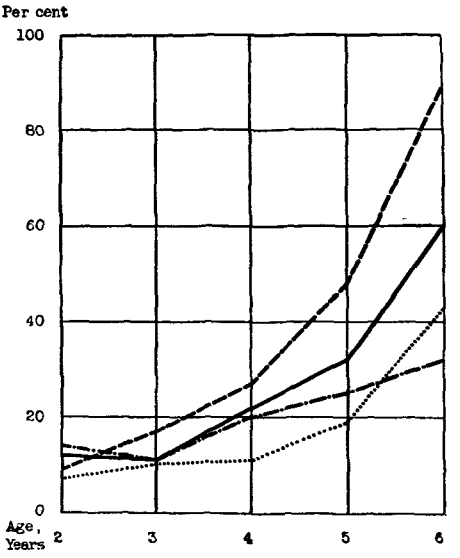

Figure 2. Percentage of sounds given correctly by age groups

———— Consonant elements (61)

— — — — Consonant blends (47)

—.—.—.—.—. Vowels (11)

. . . . . Diphthongs (4)

rectly, with the exception of one sound at six years. At five years each consonant element was given correctly by at least 40 per cent of the children, and more than half of the consonant elements were given correctly by at least 90 per cent of the children.

Consonant blends were more difficult than consonant elements. At two years of age no blend was given correctly by as many as 40 per cent of the children, eighteen of the forty-eight sounds were given correctly by less than 10 per cent of the children, and thirty-two of the forty-eight sounds by less than 20 per cent. From three years on each blend was given correctly by at least 20 per cent of the children. Except for one sound at three years, no consonant blend was given correctly by all children within an age group and not

TABLE 3
Number of Sounds Correct by Different Percentages of Children

Percentage of Children	Group A											
	All Children											
	Age, Years						Age, Years					
	2	3	4	5	6	All Ages	2	3	4	5	6	All Ages
	66 Consonant Elements						48 Consonant Blends					
100-	1	0	3	5	14	0	0	1	0	0	0	0
90-99	2	7	19	51	21	19	0	0	0	10	13	2
80-89	8	24	13	20	20	13	0	1	1	21	13	2
70-79	4	9	16	8	8	20	0	10	8	13	13	11
60-69	4	11	8	0	0	8	0	9	18	2	4	19
50-59	4	12	5	1	2	5	0	11	13	0	3	12
40-49	8	5	2	1	0	1	0	11	6	2	0	3
30-39	3	5	0	0	0	0	6	3	1	0	1	0
20-29	12	0	0	0	1	0	10	2	1	0	1	1
10-19	7	0	0	0	0	0	14	0	0	0	0	0
0- 9	13	0	0	0	0	0	18	0	0	0	0	0
	15 Vowels						4 Diphthongs					
100-	2	1	1	2	5	0	0	0	0	0	0	0
90-99	3	3	7	7	5	6	0	0	1	0	0	0
80-89	0	5	3	5	3	7	0	0	3	4	3	4
70-79	3	3	4	1	2	2	2	4	0	0	0	0
60-69	4	3	0	0	0	0	1	0	0	0	1	0
50-59	1	0	0	0	0	0	0	0	0	0	0	0
40-49	2	0	0	0	0	0	1	0	0	0	0	0
	Group B											
	Children Completely Tested on One Sound Group											
	61 Consonant Elements						47 Consonant Blends					
100-	4	0	4	21	9	0	0	1	0	3	0	0
90-99	3	9	16	21	17	13	0	0	2	21	0	0
80-89	5	8	11	11	10	8	0	3	4	17	0	1
70-79	4	13	14	4	6	9	0	5	14	4	39	3
60-69	3	6	10	2	7	17	0	6	4	1	0	17
50-59	2	10	5	0	1	9	0	11	19	1	7	17
40-49	8	7	0	1	0	4	1	7	3	0	0	7
30-39	6	6	0	1	1	0	0	7	1	0	0	2
20-29	8	1	0	0	0	1	5	6	0	0	1	0
10-19	11	1	0	0	0	0	22	1	0	0	0	0
0- 9	1	1	0	0	0	0	19	0	0	0	0	0
	11 Vowels						4 Diphthongs					
100-	2	2	0	1	2	0	0	0	0	0	3	0
90-99	0	1	2	5	4	2	0	0	0	0	0	0
80-89	1	2	4	3	2	3	0	0	0	2	1	0
70-79	3	1	3	1	2	1	1	2	0	2	0	1
60-69	1	3	1	1	1	3	1	1	2	0	0	2
50-59	2	1	1	0	0	2	0	0	2	0	0	1
40-49	0	1	0	0	0	0	0	1	0	0	0	0
30-39	2	0	0	0	0	0	1	0	0	0	0	0
20-29	0	0	0	0	0	0	0	0	0	0	0	0
10-19	0	0	0	0	0	0	1	0	0	0	0	0

until five years was any sound given correctly by as many as 90 per cent of the children.

Vowels were easier than other sound groups. At two years of age each vowel was given correctly by at least 40 per cent of the children, at three years by at least 60 per cent,

and from four years on by at least 70 per cent of the children. Each diphthong was given correctly by at least 40 per cent of the two year group and by at least 60 per cent at the other ages. No diphthong was given correctly by all of the children in any given age group.

Although certain sounds were given correctly by all of the children in given age groups, no sound was given correctly by all the children in all age groups. A sound which was given correctly by all children in one age group was not always given correctly by all of the children in the next older age group. The median for vowels and diphthongs falls within the 80-90 per cent group, for consonant elements within the 70-79 per cent group, and for consonant blends within the 60-69 per cent group.

Since the number of children in Group A varied for different sounds, the number of sounds correct is also given in Table 3 for Group B in which a given child was tested on a whole sound group, the number of children tested thus being constant for a sound group. The figures run much the same as for Group A, but slightly lower. There was an extension of the lower limits at three years on consonant elements and blends, making the range greater at this age. The median for vowels falls within the 70-79 per cent group, for diphthongs and consonant elements within 60-69 per cent, and for consonant blends within the 50-59 per cent group.

Sex Differences

As is shown in Table 4, the boys of Group B at two years gave 3.8 more consonant elements correctly than the girls, and at six years, .5 of a sound; at the other ages the girls gave more consonant elements correctly, 10.3 at three years, 8.3 at four years, and 1.6 at five years. The boys of two years were 1.2 months older than the girls of two years and the boys of six years 2.9 months older; the girls of three years were 1.1 months older than the boys, and the girls of five years were 1.4 months older, but the boys of four years were 4.2 months older. The differences between the means cannot therefore be entirely accounted for by the differences in ages.

TABLE 4

Sex Differences in Number of Speech Sounds Correct

Group B														
Children Completely Tested on One Sound Group														
		Boys							Girls					
Age, Years	Number of Children	Mean Age, Months	Standard Deviation	Mean Number of Sounds Correct	Standard Deviation	Standard Deviation of Mean	Age, Years	Number of Children	Mean Age, Months	Standard Deviation	Mean Number of Sounds Correct	Standard Deviation	Standard Deviation of Mean	Ratio of Difference to Standard Deviation of Difference
Consonant Elements														
2	5	27.8	1.72	26.2	11.6	5.20	2	5	26.6	2.06	22.4	6.7	2.99	.63
3	11	38.4	3.04	35.6	11.1	3.35	3	16	39.5	2.63	45.9	8.9	2.22	2.56
4	21	51.5	3.80	44.1	11.8	2.58	4	14	47.3	3.97	52.4	7.8	2.09	2.50
5	24	58.4	3.25	53.6	4.7	.96	5	13	59.8	2.64	55.2	3.7	1.03	1.13
6	3	72.3	3.32	53.4	3.2	1.85	6	8	69.4	3.12	52.9	8.0	2.83	.15
Vowels														
2	4	28.0	1.16	7.3	1.9	.95	2	4	25.8	1.30	8.7	1.3	.63	1.22
3	11	36.7	2.54	8.5	1.5	.45	3	15	37.7	3.18	8.1	1.8	.46	.62
4	17	49.4	2.78	9.1	1.3	.31	4	11	48.0	3.46	8.5	1.5	.45	1.11
5	25	58.8	3.47	10.2	.92	.18	5	12	60.2	2.51	10.3	5.0	1.44	.07
6	5	70.5	2.80	9.8	2.4	1.08	6	9	68.3	2.44	9.3	1.6	.53	.42

Ratios of the differences in the number of sounds correct to the standard deviations of the differences were low for consonant elements, the only differences that approached true differences being at three and four years, where the girls were in advance of the boys. At four years it is possible that the mean for girls might have been higher had the mean age for girls been equal to that of the boys. The boys at four years were 4.2 months older than the girls, and the ratio of the age differences was 3.11, indicating a true age difference. The ratios for other age differences were at three years .97 and at five years 1.43. Girls at three years showed as high a mean score on consonant elements as boys at four years, and girls at four years almost as high as boys at five years.

For vowels, the mean scores for boys were ahead of those for girls, .4 of a sound at three years, .6 at four years, and .5 at six years, while the girls were ahead 1.4 at two years and .1 at five years. None of these differences was significant, the ratios varying from .07 to 1.22. No definite conclusion can be made as to sex differences on vowels.

The sixty-five children tested on consonant blends did not divide into the sexes in such a way that adequate comparison could be made, and the small number of diphthongs made comparison on that sound group inadvisable.

Relative Difficulty of Different Sounds

The relative difficulty of the different sounds was determined through: (1) the number and percentage of children giving correct responses on each sound, (2) the relative ranking of the sounds in age groups, (3) correlations between age groups, (4) the number of correct responses according to position of the sound in a word, and (5) the rank of sounds in age groups according to position.

Number and Percentage of Children Giving Correct Responses on Each Sound.

Table 5 gives the number of children tested on each sound and the number and percentage of children giving correct responses on each sound. The number of children tested on consonant elements varied from seventy-two on *–j–* to 204 on *–p–*,

TABLE 5

Number of Children Tested and Number and Percentage Giving Sounds Correctly

Sound	Group A																	
	All Children																	
	Number Children Tested						Number Giving Sound Correctly						Per Cent Giving Sound Correctly					
	Age, Years					Total	Age, Years					Total	Age, Years					Mean
	2	3	4	5	6		2	3	4	5	6		2	3	4	5	6	
							Consonant Elements											
p-	15	40	43	70	27	195	13	35	38	68	27	181	86.7	87.5	88.4	97.1	100.0	92.8
-p-	15	39	53	70	27	204	12	36	48	68	25	189	80.0	92.3	90.6	97.1	92.6	92.6
-p	15	39	53	70	27	204	7	27	42	60	26	162	46.7	69.2	79.2	85.7	96.3	79.4
b-	15	39	53	70	27	204	14	36	52	69	27	198	93.3	92.3	98.1	98.6	100.0	97.1
-b-	14	39	50	70	27	200	13	37	48	70	26	194	92.8	94.9	96.0	100.0	96.3	97.0
-b	14	38	51	70	27	200	4	33	46	63	19	165	28.6	86.8	90.2	90.0	70.4	82.5
t-	15	39	53	68	27	202	12	35	51	67	27	193	80.0	89.7	96.2	98.5	100.0	95.5
-t-	15	39	53	70	27	204	6	23	35	57	15	136	40.0	59.0	66.0	81.4	55.6	66.7
-t	15	37	53	68	27	200	10	28	48	59	23	168	66.7	75.7	90.6	86.8	85.2	84.0
d-	15	37	51	69	27	199	13	35	48	68	27	191	86.7	94.6	94.1	98.6	100.0	96.0
-d-	15	37	52	69	27	200	7	28	37	66	24	162	46.7	75.7	71.1	95.7	88.9	81.0
-d	15	38	53	69	27	202	5	28	41	63	24	161	33.3	73.7	77.3	91.3	88.9	79.7
k-	15	39	53	69	27	203	10	32	46	68	27	183	66.7	82.1	86.8	98.5	100.0	90.1
-k-	14	39	52	70	27	202	9	33	47	65	26	180	64.3	84.6	90.4	92.8	96.3	89.1
-k	15	37	52	70	27	201	7	27	43	67	24	168	46.7	73.0	82.7	97.1	88.9	83.6
g-	14	39	53	69	27	202	8	34	48	65	26	182	57.1	87.2	90.6	94.2	96.3	90.1
-g-	14	38	53	65	27	197	10	34	47	64	25	180	71.4	89.5	88.7	98.5	92.6	91.4
-g	15	39	53	67	27	201	7	29	47	61	22	166	46.7	74.4	88.7	91.0	81.5	82.6
m-	15	39	50	70	27	201	13	38	50	70	27	198	86.7	97.4	100.0	100.0	100.0	98.5
-m-	15	37	51	69	27	199	13	34	51	68	27	193	86.7	91.9	100.0	98.6	100.0	97.0
-m	15	39	51	70	27	202	11	35	49	69	27	191	73.3	89.7	96.1	98.6	100.0	94.6
n-	15	38	53	69	27	202	15	37	53	68	25	198	100.0	97.4	100.0	98.6	92.6	98.0
-n-	14	38	50	69	27	198	12	34	46	66	26	184	85.7	89.5	92.0	95.7	96.3	92.9
-n	14	39	53	69	27	202	7	32	49	69	27	184	50.0	82.1	92.4	100.0	100.0	91.1
-ŋ-	13	28	34	48	24	147	7	25	32	44	22	130	53.8	89.3	94.1	91.7	91.7	88.4
-ŋ	15	39	53	69	27	203	9	22	27	35	15	108	60.0	56.4	50.9	50.7	55.5	53.2
M-	15	39	53	70	27	204	4	25	26	61	20	136	26.7	64.1	49.0	87.1	74.1	66.7
W-	14	39	52	70	27	202	11	35	48	69	27	190	78.6	89.7	92.3	98.5	100.0	94.1

-w-	12	31	34	48	25	150	9	25	31	41	20	126	75.0	80.6	91.2	85.4	80.0	84.0
f-	15	39	52	70	25	203	8	33	48	70	27	186	53.3	84.6	92.3	100.0	100.0	91.6
-f-	14	37	49	67	26	193	4	32	48	65	25	174	28.6	86.5	97.9	97.0	96.1	90.1
-f	15	39	51	67	27	199	6	33	46	65	25	175	40.0	84.6	90.2	97.0	92.6	87.9
v-	14	38	53	69	21	201	0	22	38	58	19	137	0.0	57.9	71.7	84.0	70.3	68.1
-v-	14	38	52	64	26	194	2	25	36	57	23	143	14.3	65.8	69.2	89.1	88.5	73.7
-v	15	38	51	67	27	198	3	23	39	62	24	151	20.0	60.5	76.5	92.5	88.9	76.3
θ-	15	39	53	70	27	204	3	14	27	53	24	121	20.0	35.9	50.9	75.7	88.9	59.3
-θ-	15	38	50	65	27	195	1	17	29	48	20	115	6.7	44.7	58.0	73.8	74.1	58.9
-θ	15	39	50	70	27	201	2	15	24	54	23	118	6.7	44.7	58.0	73.8	74.1	58.9
ð-	15	39	53	68	27	202	1	15	26	54	24	120	6.7	38.5	49.0	79.4	88.9	59.4
-ð-	13	38	43	63	25	182	0	17	26	57	20	120	0.0	44.7	60.5	90.5	80.0	65.9
-ð	15	39	49	67	26	196	0	12	28	32	7	79	0.0	30.7	57.1	47.7	26.9	40.3
s-	15	39	53	70	27	204	1	20	34	54	20	129	6.7	51.3	64.1	77.1	74.1	62.7
-s-	14	39	53	67	27	200	2	27	37	56	24	146	14.3	69.2	69.8	83.6	88.9	73.0
-s	15	39	53	69	27	203	4	30	43	56	24	157	40.0	58.9	66.0	75.3	77.7	67.5
z-	14	38	51	68	27	198	2	23	37	59	21	142	14.3	60.5	72.5	86.7	77.7	71.7
-z-	13	37	49	67	27	193	2	28	41	60	23	154	15.4	75.6	83.6	89.5	85.1	79.6
-z	15	39	53	68	27	202	4	30	43	56	24	157	26.6	76.9	81.1	82.3	88.9	77.7
ʃ-	15	37	53	69	27	201	1	17	39	61	26	144	6.6	45.9	73.6	88.4	96.3	71.6
-ʃ-	13	38	50	61	27	189	1	19	35	54	25	134	7.7	50.0	70.0	88.5	92.6	70.3
-ʃ	14	39	53	68	27	201	1	15	37	60	27	140	7.1	38.4	69.6	88.2	100.0	69.6
ʒ	14	37	52	63	27	193	3	17	37	56	24	137	21.4	45.9	71.1	88.9	88.9	70.9
tʃ-	14	39	53	69	26	201	3	23	38	61	24	149	21.4	58.9	71.7	88.4	92.3	74.1
-tʃ-	13	29	42	56	26	166	2	17	30	48	24	121	15.4	58.6	71.4	85.7	92.3	72.8
-tʃ	13	39	49	65	26	192	2	23	39	64	24	152	15.4	58.9	79.6	98.4	92.3	79.1
dʒ-	14	38	53	68	27	200	4	28	46	61	22	161	28.5	73.6	80.8	89.7	81.5	80.5
-dʒ-	13	29	36	58	27	163	2	15	31	47	24	119	15.4	51.7	86.1	81.0	88.9	73.0
-dʒ	13	33	38	60	27	171	1	13	27	44	25	110	7.7	39.4	71.0	73.3	92.6	64.3
l-	14	38	53	69	27	201	5	27	42	63	26	163	35.7	71.0	79.2	91.3	96.3	81.1
-l-	13	38	53	66	27	197	3	25	47	61	27	163	23.0	65.8	88.6	92.4	100.0	82.7
-l	15	39	53	68	26	201	3	20	44	53	21	141	20.0	51.3	83.0	77.9	80.7	70.1
r-	15	39	53	69	27	203	6	24	34	61	25	150	40.0	61.5	64.1	88.4	92.6	73.9
-r-	14	38	46	64	27	189	1	21	35	55	26	138	6.6	55.2	76.1	85.9	96.3	73.0
-r	15	37	50	68	27	197	3	25	40	60	26	154	20.0	67.5	80.0	88.2	96.3	78.1
j-	15	38	53	68	27	201	5	23	41	65	23	157	33.3	60.5	77.3	95.6	85.2	78.1
-j-	0	17	26	24	5	72	0	11	23	23	4	61	0.0	64.6	88.4	95.8	80.0	82.2
h	15	38	50	70	27	200	13	34	48	69	26	190	86.6	89.4	96.0	98.5	96.3	95.0

TABLE 5 (Continued)

Number of Children Tested and Number and Percentage Giving Sounds Correctly

Sound	Group A — All Children																	
	Number Children Tested						Number Giving Sound Correctly						Per Cent Giving Sound Correctly					
	Age, Years					Total	Age, Years					Total	Age, Years					Mean
	2	3	4	5	6		2	3	4	5	6		2	3	4	5	6	
Consonant Blends																		
mp	13	31	34	53	25	156	3	25	26	52	23	129	23.1	80.6	76.5	98.1	92.0	82.7
mz	13	30	34	62	23	162	3	20	21	47	18	109	23.1	66.7	61.8	75.8	78.3	67.3
nt	13	29	34	55	24	155	4	17	27	44	17	109	30.8	58.6	79.4	80.0	70.8	70.3
nd	13	31	35	53	27	159	1	12	23	38	21	95	7.7	38.7	65.7	71.7	77.8	59.7
ns	14	31	34	49	24	152	3	19	22	41	20	105	21.4	61.3	64.7	83.7	83.3	69.1
nz	13	30	34	54	25	156	4	19	22	46	19	110	30.8	63.3	64.7	85.2	76.0	70.5
ŋk	13	31	33	52	25	154	4	21	30	47	22	124	30.8	67.7	90.9	90.4	88.0	80.5
ŋg	13	29	34	47	24	147	2	11	20	36	19	88	15.4	37.9	58.8	76.6	79.2	59.9
ŋz	13	31	34	50	26	154	3	19	25	39	18	104	23.1	61.3	73.5	78.0	69.2	67.5
sp	13	37	42	62	26	180	2	17	28	55	22	124	15.4	45.9	66.7	88.7	84.6	68.9
st-	15	38	47	66	27	193	2	18	30	56	26	132	13.3	47.4	63.8	84.8	96.3	68.4
-st	13	29	35	46	24	147	1	12	15	22	14	64	7.7	41.4	42.8	47.8	58.3	43.5
sk	14	30	38	52	24	158	1	14	18	45	19	97	7.1	46.7	47.4	86.5	79.2	61.4
sm	15	34	35	62	26	172	1	19	20	50	18	108	6.7	55.9	57.1	80.6	69.2	62.8
sn	13	30	34	50	24	151	2	12	21	38	17	90	15.4	40.0	61.8	76.0	70.8	59.6
sw-	13	30	34	52	24	153	2	13	19	43	18	95	15.4	43.3	55.9	82.7	75.0	62.1
sl	16	33	37	55	24	165	0	12	20	42	19	93	0.0	36.4	54.1	76.4	79.2	56.4
spr-	13	30	34	48	25	150	2	10	18	39	18	87	15.4	33.3	52.9	81.3	72.0	58.0
str-	13	31	34	56	25	159	2	12	17	43	23	97	15.4	38.7	50.0	76.8	92.0	61.0
skr-	13	26	34	50	24	147	2	7	14	40	18	81	15.4	26.9	41.1	80.0	75.0	55.1
spl-	13	30	34	47	24	148	0	9	18	35	15	77	0.0	30.0	52.9	74.4	62.5	52.0
skw-	13	32	42	52	24	163	0	12	28	39	20	99	0.0	37.5	66.7	75.0	83.3	60.8
-ps	13	30	34	53	25	155	2	20	24	48	22	116	15.4	66.7	70.6	90.6	88.0	74.8
-ts	14	29	34	53	25	155	5	18	20	41	20	104	35.7	62.0	58.8	77.3	80.0	67.1
ks	12	29	35	57	25	158	3	12	25	53	20	113	25.0	41.4	71.4	92.9	80.0	71.5
-dz	13	30	34	48	24	149	1	8	21	40	17	87	7.7	26.7	61.8	83.3	70.8	58.3
-gz	13	30	37	51	24	155	4	12	19	40	14	89	30.8	66.7	51.3	78.4	58.3	57.4
-lz	13	30	34	56	27	160	3	14	20	43	22	102	23.1	46.7	58.8	76.8	81.5	63.7
pr	12	30	34	51	25	152	3	10	15	41	18	87	25.0	33.3	44.1	80.4	72.0	57.2
br	15	41	52	63	25	196	2	21	32	52	23	130	13.3	51.2	61.5	80.9	92.0	66.3

tr	14	34	49	64	26	187	2	19	31	57	23	132	14.3	55.9	63.3	89.1	88.5	70.6
dr	13	33	46	63	26	181	2	17	33	56	24	132	15.4	51.5	71.7	88.7	92.3	72.9
kr	13	35	41	58	25	172	2	17	26	48	24	117	15.4	48.6	63.4	82.7	96.0	68.0
gr	13	36	49	66	26	190	3	22	34	58	21	138	23.1	61.1	69.4	87.9	80.8	72.6
fr	13	30	34	53	26	156	3	11	19	49	22	104	23.1	36.7	55.9	92.4	84.6	66.7
θr	13	31	34	62	27	167	0	6	11	46	22	85	0.0	19.3	32.3	74.2	81.5	50.9
sk	13	29	33	47	22	144	1	9	16	30	7	63	7.7	31.0	48.5	63.8	31.8	43.7
sf	13	29	34	48	23	147	0	8	23	39	14	84	0.0	27.6	67.6	81.2	60.9	57.1
lv	13	30	34	48	23	148	0	12	18	41	21	92	0.0	40.0	52.9	85.4	91.3	62.1
ld	13	30	34	51	25	153	0	10	16	35	13	74	0.0	33.3	47.1	68.6	52.0	48.4
tl	13	31	34	51	24	153	0	6	8	21	7	42	0.0	19.3	23.5	41.2	29.2	27.4
pl	14	36	44	55	27	176	1	19	26	51	25	122	7.1	52.8	59.2	92.7	92.6	69.3
bl	14	41	48	65	26	194	2	22	32	58	24	138	14.3	53.6	66.7	89.2	92.3	71.1
ɹ	13	34	44	54	25	170	1	14	31	49	23	118	7.7	41.2	70.4	90.7	92.0	69.4
kl	14	35	39	56	24	168	0	15	27	50	23	115	0.0	42.8	69.2	89.3	95.8	68.4
gl	13	30	34	50	24	151	1	16	24	45	23	109	7.7	53.3	70.6	90.0	95.8	72.2
tw	13	29	34	50	25	151	5	15	21	45	23	109	38.5	51.7	61.8	90.0	92.0	72.2
kw	13	30	37	50	25	155	3	20	28	47	22	120	23.1	66.7	75.7	94.0	88.0	77.4
Vowels																		
i	15	38	50	68	27	198	15	34	47	67	27	190	100.0	87.5	94.0	98.5	100.0	95.9
ɪ	14	36	54	68	27	199	9	22	50	52	24	157	64.3	61.1	92.5	76.5	88.9	78.9
e	15	38	52	65	25	195	6	28	46	60	24	170	40.0	73.7	88.5	92.3	96.0	87.2
ɛ	15	28	53	63	26	185	11	27	39	55	20	152	73.3	96.4	73.6	87.3	76.9	82.2
ɛ:	3	12	10	18	3	46	2	10	7	18	3	40	66.7	83.3	70.0	100.0	100.0	86.9
æ	15	40	53	67	27	202	9	27	40	61	21	158	60.0	67.5	75.5	91.0	77.8	78.2
ɑ	14	38	44	58	26	180	11	35	41	52	24	163	78.6	92.1	93.2	89.2	92.3	90.6
u	14	33	45	56	26	174	13	32	43	55	23	166	92.8	96.9	95.5	98.2	88.5	95.4
ʊ	12	22	29	43	3	109	5	15	27	38	3	88	41.7	63.2	93.1	88.4	100.0	80.7
o	14	35	49	65	27	190	13	31	45	63	24	176	92.8	88.6	91.8	96.9	88.9	90.5
ɔ:	15	37	48	66	27	193	8	30	39	64	27	168	53.3	81.1	81.2	96.9	100.0	87.0
ɔ	5	19	17	29	21	91	3	14	15	27	19	78	60.0	73.7	88.2	93.1	90.5	85.7
ə	8	28	39	38	24	137	6	22	28	33	23	112	75.0	78.6	71.8	86.8	94.8	81.7
ʌ	14	38	52	68	27	199	13	32	44	68	26	183	92.8	84.2	84.6	100.0	96.3	91.9
ə	13	33	42	64	27	179	13	33	38	57	27	168	100.0	100.0	90.5	89.1	100.0	93.8
Diphthongs																		
aɪ	15	37	53	66	27	198	6	28	45	57	24	160	40.0	75.7	84.9	86.4	83.9	80.8
aʊ	15	39	49	67	27	197	11	30	40	56	23	160	73.3	76.9	81.6	83.6	85.2	81.2
ɔɪ	14	37	47	67	27	192	10	29	38	56	23	156	71.4	78.4	80.8	83.6	85.2	81.2
ju	13	34	43	64	26	180	9	26	42	57	18	152	69.2	76.5	97.7	89.1	69.2	84.4

-p, *b-*, *-t-*, *m*, *ɵ-*, and *s-*. More than 190 children were tested on all consonant elements except nine; these nine sounds included seventy-two children on *-j-*, 147 on *-ŋ-*, 150 on *-w-*, 163 on *-dʒ-*, 166 on *-tʃ-*, 171 on *-dʒ*, 182 on *-ð-*, 189 on *-ʃ-*, and 189 on *-r-*. The smaller number of children tested on some sounds may indicate greater difficulty of the sounds and hence lack of attempt by the child, a smaller frequency of the sounds in the conversation of the child, insufficient time on the part of the examiner, or faulty technique of the test in eliciting responses containing the desired sounds.

The number of children tested on the different blends varied from 144 to 196. For vowels the number tested varied from 46 to 202. For all but four vowels 170 or more children were tested; these four included 46 children on ɛ:, 91 on ə, 109 on ʊ, and 137 on ɔ. From 180 to 198 children were tested on each of the four diphthongs.

The percentages of children giving each consonant element correctly (Table 5) varied from 40.3 for *-ð* to 98.5 for *m-*, the other sounds being quite evenly distributed between these two. On the sound *n-* 98.0 per cent of the children gave a correct response, on *b-* 97.1 per cent, on *-b-* and *-m-* 97.0 per cent, on *d-* 96.0 per cent, on *t-* 95.5 per cent and on *h* 95.0 per cent. On *-ŋ* only 53.2 per cent of the children gave a correct response, on *-ɵ-* and *-ɵ* only 58.9 per cent, on *ɵ-* only 59.3 per cent and on *ð-* only 59.4 per cent.

The percentages of children giving each consonant blend correctly varied from 27.4 for *tl* to 82.7 for *mp*, with the other sounds falling chiefly between 50 and 75 per cent. The sound *ŋk* was given correctly by 80.5 per cent of the children, and *kw* by 77.4 per cent. Only 43.5 per cent of the children gave *-st* correctly, 43.7 per cent *lk*, and 48.4 per cent *ld*.

For vowels the percentages of children giving correct responses ranged from 78.2 for *æ* to 95.9 for *i*. For diphthongs the percentages ranged only from 80.8 to 84.4. The variations between sounds were thus considerably less for vowels and diphthongs than for consonant elements and blends.

In Table 6 are given the results for each sound for Group B, 120 children who were completely tested on 61 consonant elements, 65 children who were completely tested on 47 consonant blends, 113 children who were completely tested on 11 vowels, and 113 children who were completely tested on 4 diphthongs. This

table makes possible more adequate comparison of all sounds within a sound group than could be made with the data presented in Table 5, because of the varying numbers of children in Group A tested on the different sounds. The consonant elements that were omitted from consideration in Group B because of lack of complete information were *-ŋ-*, *-w-*, *-dʒ-*, *-dʒ*, and *-j-*. The consonant blend omitted was *tl*, and the vowels omitted were ɛː, ʊ, ɔ, and ɵ.

When only those children completely tested on a given sound group were considered (Table 6), the percentages of children giving the consonant elements correctly ranged from 22.2 for *-ð* to 99.3 for *-m-*, with a fairly even distribution from 47 to 99 per cent. The consonant elements *m-* and *n-* were given correctly by 98.6 per cent of the children, *p-* by 98.0 per cent, *d-* by 96.7 per cent, and *-b-* by 95.9 per cent. Only 47.6 per cent gave *-ɵ* correctly, 47.8 per cent *ð-* and 48.1 per cent *ɵ-*.

The percentages of children in Group B giving consonant blends correctly ranged from 37.4 on *ɵr* to 83.7 on *-ps*, with about three-fourths of the sounds falling between 40 and 70 per cent. The blend *ŋk* was given correctly by 77.9 per cent of the children, *kw* by 71.9 per cent and *mp* by 70.7 per cent. Only 39.3 per cent gave *-st* correctly, only 40.0 per cent *nd* and 40.5 per cent *lk*.

Vowels were given correctly by from 54.1 (for ʊ) to 98.2 (for *i*) per cent of the children. The vowel *ə* was given correctly by 95.3 per cent of the children, while *æ* was given correctly by only 57.8 per cent and *ɪ* by only 60.1 per cent.

Diphthongs were given correctly by 59.9 to 77.9 per cent of the children. The percentages for consonant elements, vowels, and diphthongs for this group of children run to somewhat lower limits than when all children (Group A) are considered.

Table 7, including only those children who were completely tested on all four sound groups, makes possible comparison between the sound groups as well as between the different sounds within a group, since all of the children in Group C were tested on every sound. There was a wide variation within the consonant element group in the percentage of children giving each sound correctly; the consonant blend group was more evenly distributed and the diphthongs were most closely grouped. There was a

variation of 84.1 per cent between the easiest and the most difficult consonant elements, 45.1 and 43.3 per cent between the easiest and most difficult consonant blends and vowels respectively, while the widest differences between diphthongs was only 18.3 per cent. The sounds that were given correctly by 90 to 100 per cent of the children included sixteen consonant elements, *t–*, *p–*, *–b–*, *–m–*, *b–*, *m–*, *n–*, *–n–*, *f–*, *p–*, *d–*, *h*, *w–*, *–g–*, *–k–*, and *–m*; no consonant blends; four

TABLE 6

Number and Percentage of Children Giving Sounds Correctly

Sound	Group B											
	Children Completely Tested on One Sound Group											
	Number Giving Sound Correctly						Per Cent Giving Sound Correctly					
	Age, Years					Total	Age, Years					Mean
	2	3	4	5	6		2	3	4	5	6	
Consonant Elements												
p-	10	26	34	36	11	117	100.0	92.9	97.1	100.0	100.0	98.0
-p-	8	27	33	36	10	114	80.0	96.4	94.3	100.0	90.9	92.3
-p	5	24	30	31	10	100	50.0	85.7	85.7	86.1	90.9	79.7
b-	9	25	32	36	11	113	90.0	89.3	91.4	100.0	100.0	94.0
-b-	9	26	32	36	11	114	90.0	92.9	91.4	100.0	100.0	95.9
-b	4	21	28	33	7	93	40.0	75.0	80.0	91.7	63.6	70.1
t-	7	21	35	36	11	100	70.0	75.0	100.0	100.0	100.0	89.0
-t-	2	15	25	26	7	75	20.0	53.6	71.4	72.2	63.6	56.2
-t	3	16	29	32	7	87	30.0	57.1	84.9	88.9	63.6	64.9
d-	9	27	34	36	11	117	90.0	96.4	97.1	100.0	100.0	96.7
-d-	6	18	26	34	11	95	60.0	64.4	74.3	94.4	100.0	78.6
-d	4	23	28	35	9	99	40.0	82.1	80.0	97.2	81.8	76.2
k-	7	22	30	35	11	105	70.0	78.6	85.7	97.2	100.0	86.3
-k-	6	22	34	35	10	107	60.0	78.6	97.1	97.2	90.9	84.8
-k	4	22	28	36	9	99	40.0	78.6	80.0	100.0	81.8	92.1
g-	6	21	33	36	10	106	60.0	75.0	94.3	100.0	90.9	84.0
-g-	8	24	34	36	10	112	80.0	85.7	97.1	100.0	90.9	90.7
-g	5	21	32	35	8	101	50.0	75.0	91.4	97.2	72.7	77.3
m-	10	26	35	36	11	118	100.0	92.9	100.0	100.0	100.0	98.6
-m-	10	27	35	36	11	119	100.0	96.4	100.0	100.0	100.0	99.3
-m	8	26	33	36	11	114	80.0	92.9	94.3	100.0	100.0	93.4
n-	10	26	35	36	11	118	100.0	92.9	100.0	100.0	100.0	98.6
-n-	8	25	32	36	10	111	80.0	89.3	91.4	100.0	90.9	90.3
-n	4	25	32	36	11	108	40.0	89.3	91.4	100.0	100.0	84.0
-ŋ	5	23	26	29	9	92	50.0	82.1	74.3	80.6	81.8	73.8
M-	2	16	24	34	8	84	20.0	57.1	68.6	94.4	72.7	62.6
w-	8	22	34	32	11	107	80.0	78.6	97.1	88.9	100.0	88.9
f-	7	22	32	36	11	108	70.0	78.6	91.4	100.0	100.0	88.0
-f-	4	24	34	36	11	109	40.0	85.7	97.1	100.0	100.0	84.6
-f	4	23	31	34	9	101	40.0	82.1	88.6	94.4	81.8	77.4
v-	0	13	26	32	6	77	0.0	46.4	74.3	88.9	54.5	52.8
-v-	0	17	22	34	10	83	0.0	60.7	64.9	94.4	90.9	62.2
-v	1	15	26	33	10	84	10.0	53.6	74.3	91.7	90.9	64.1
θ-	0	9	20	25	9	63	0.0	32.1	57.1	69.4	81.8	48.1
-θ-	1	12	18	27	9	67	10.0	42.9	51.4	75.0	81.8	52.2
-θ	1	4	20	27	9	61	10.0	14.3	57.1	75.0	81.8	47.6
ð-	0	9	22	25	8	64	0.0	32.1	64.9	69.4	72.7	47.8
-ð-	0	11	26	31	9	77	0.0	39.3	74.3	86.1	81.8	56.1
-ð	0	2	8	16	4	30	0.0	7.1	22.8	44.4	36.5	22.2
s-	1	15	23	30	8	77	10.0	53.6	65.7	83.3	72.7	59.1
-s-	2	20	22	30	8	82	20.0	71.4	64.9	83.3	72.7	64.5
-s	4	17	20	29	7	77	40.0	60.7	57.1	80.6	63.6	60.4
z-	1	16	24	32	10	83	10.0	57.1	68.6	88.9	90.9	63.1
-z-	2	21	29	36	10	98	20.0	75.0	84.9	100.0	90.9	74.2
-z	2	19	28	33	11	93	20.0	67.1	80.0	91.7	100.0	71.8

TABLE 6 (Continued)

Number and Percentage of Children Giving Sounds Correctly

Sound	Group B											
	Children Completely Tested on One Sound Group											
	Number Giving Sound Correctly						Per Cent Giving Sound Correctly					
	Age, Years					Total	Age, Years					Mean
	2	3	4	5	6		2	3	4	5	6	
Consonant Elements												
f-	2	12	27	35	9	85	20.0	42.9	77.1	97.2	81.8	63.8
-f-	1	12	24	34	11	82	10.0	42.9	68.6	94.4	100.0	63.2
-f	0	8	23	36	11	78	0.0	28.6	65.7	100.0	100.0	58.9
ʃ	1	11	26	33	9	80	10.0	39.3	74.3	91.7	81.8	59.4
tʃ-	1	15	28	36	9	87	10.0	53.6	74.3	100.0	81.8	63.9
-tʃ-	1	15	25	33	10	84	10.0	53.6	71.4	91.7	90.0	53.3
-tʃ	1	16	25	35	10	87	10.0	57.1	71.4	97.2	90.0	65.1
dʒ-	3	18	30	32	8	91	30.0	64.4	85.7	88.9	72.7	68.3
l-	4	18	27	35	10	94	40.0	64.4	77.1	97.2	90.0	73.7
-l-	2	20	30	33	7	92	20.0	71.4	85.7	91.7	63.6	66.5
-l	1	12	21	28	7	69	10.0	42.9	60.0	77.8	63.6	50.9
r-	3	11	24	32	10	80	30.0	39.3	68.6	88.9	90.0	63.4
-r-	1	12	27	34	10	84	10.0	42.9	77.1	94.4	90.0	62.9
-r	3	12	27	34	10	86	30.0	42.9	77.1	94.4	90.0	66.9
j-	2	14	26	33	10	85	20.0	50.0	74.3	91.7	90.0	65.2
h	7	27	33	36	11	114	70.0	96.4	94.3	100.0	100.0	92.1
Consonant Blends												
mp	1	17	16	20	2	56	14.3	100.0	94.1	95.2	50.0	70.7
mz	1	11	12	16	3	43	14.3	64.7	70.6	76.2	75.0	60.2
nt	2	13	11	17	3	46	28.6	76.5	64.7	80.9	75.0	65.1
nd	0	6	10	17	1	34	0.0	35.3	58.8	80.9	25.0	40.0
ŋz	1	12	12	20	3	48	14.3	70.6	70.6	95.2	75.0	65.1
ŋz	1	11	13	20	2	47	14.3	64.7	76.5	95.2	50.0	60.1
ŋk	3	14	16	20	3	56	42.8	82.3	94.1	95.2	75.0	77.9
ŋg	1	10	12	19	3	45	14.3	58.8	70.6	90.5	75.0	61.8
ŋz	2	13	12	18	3	48	28.6	76.5	70.6	85.8	75.0	67.3
sp	1	10	12	20	3	46	14.3	58.8	70.6	95.2	75.0	62.8
spl-	1	9	11	18	3	32	14.3	52.9	64.7	85.8	75.0	58.5
-st	0	8	8	11	2	29	0.0	47.1	47.1	52.4	50.0	39.3
st	1	9	9	18	3	40	14.3	52.9	52.9	85.8	75.0	56.2
str	1	10	10	19	3	43	14.3	58.8	58.8	90.5	75.0	62.3
str	1	6	12	18	3	40	14.3	35.3	70.6	85.8	75.0	53.3
skr-	1	10	9	17	3	40	14.3	58.8	52.9	80.9	75.0	56.4
sl	0	7	8	17	3	35	0.0	41.2	47.1	80.9	75.0	48.8
spr-	1	6	10	18	3	38	14.3	35.3	58.8	85.8	75.0	53.8
str-	1	6	10	19	3	39	14.3	35.3	58.8	90.5	75.0	54.8
skr-	0	4	7	19	2	32	0.0	23.5	41.2	90.5	50.0	41.0
spl-	0	4	9	18	3	34	0.0	23.5	52.9	85.8	75.0	47.4
skw-	0	5	10	16	3	34	0.0	29.4	58.8	76.2	75.0	47.9
-ps	0	14	12	20	3	49	0.0	82.3	70.6	95.2	75.0	68.7
-ts	2	12	13	18	3	48	28.6	70.6	76.5	85.8	75.0	67.3

vowels, *i*, ɑ, ə and *u*; and one diphthong, *ɔI*. The sounds that were given correctly by less than 50 per cent of the children included two consonant elements, *-ɵ* and *-ð*; four consonant blends, *ər, nd, skr-*, and *lk*; no vowels and no diphthongs.

Difficulty of Specific Sounds in Relation to Age

The sounds that were given correctly by 75 per cent or more of the children may be considered as tentative norms for the age groups. In the following tabulation the percent-

TABLE 6 (Continued)

Number and Percentage of Children Giving Sounds Correctly

Sound	Group B											
	Children Completely Tested on One Sound Group											
	Number Giving Sound Correctly						Per Cent Giving Sound Correctly					
	Age, Years					Total	Age, Years					Mean
	2	3	4	5	6		2	3	4	5	6	
Consonant Blends												
ks	1	11	13	20	3	48	14.3	64.7	76.5	95.2	75.0	65.1
-dz	1	4	14	20	3	42	14.3	23.5	82.3	95.2	75.0	58.1
-gz	2	9	13	18	3	45	28.6	52.9	76.5	85.8	75.0	63.8
-lz	0	11	13	18	3	45	0.0	64.7	76.5	85.8	75.0	60.4
pr	1	7	10	19	2	39	14.3	41.2	58.8	90.5	50.0	51.0
br	1	6	10	18	3	38	14.3	35.3	58.8	85.8	75.0	53.8
tr	1	11	11	20	3	46	14.3	64.7	64.7	95.2	75.0	62.8
dr	0	10	14	20	3	47	0.0	58.8	82.3	95.2	75.0	62.3
kr	1	7	12	18	3	41	14.3	41.2	70.6	85.8	75.0	57.4
gr	1	11	12	19	3	46	14.3	64.7	70.6	90.5	75.0	63.0
fr	1	6	10	20	3	40	14.3	35.3	58.8	95.2	75.0	55.7
θr	0	2	6	14	3	25	0.0	11.8	35.3	66.7	75.0	37.4
lk	0	4	9	16	2	31	0.0	23.5	52.9	76.2	50.0	40.5
lf	0	5	15	17	3	43	0.0	29.4	88.2	80.9	75.0	54.7
lv	0	10	10	19	3	42	0.0	58.8	58.8	90.5	75.0	56.6
ld	0	7	10	15	2	34	0.0	41.2	58.8	71.4	50.0	44.3
lt	0	8	9	20	3	40	0.0	47.1	52.9	95.2	75.0	54.0
ld	0	8	11	17	3	39	0.0	47.1	64.7	80.9	75.0	53.5
ll	0	6	9	19	3	27	0.0	35.3	52.9	90.5	75.0	50.7
kl	0	10	10	20	3	43	0.0	58.8	58.8	95.2	75.0	69.4
gl	0	9	10	21	3	43	0.0	52.9	58.8	100.0	75.0	57.3
tw	2	12	10	21	3	48	28.6	70.6	58.8	100.0	75.0	66.6
kw	1	14	15	21	3	54	14.3	82.3	88.2	100.0	75.0	71.9
Vowels												
i	8	26	27	35	14	110	100.0	100.0	96.4	94.6	100.0	98.2
ɪ	4	12	19	24	10	69	50.0	46.1	67.8	64.9	71.5	30.1
e	3	17	22	32	12	86	37.5	65.4	78.6	86.5	85.7	69.7
ɛ	5	16	21	31	9	82	62.5	61.5	75.0	83.8	64.3	69.4
æ	3	13	14	26	11	67	37.5	50.0	50.0	72.7	78.6	57.8
ɑ	6	23	25	33	13	100	75.0	88.5	89.3	89.2	92.8	87.0
u	7	26	24	36	14	107	87.5	100.0	85.7	97.3	100.0	54.1
o	6	21	23	34	13	97	75.0	87.8	82.1	92.4	92.8	86.1
ɔ	4	19	23	37	12	95	50.0	71.5	82.1	100.0	85.7	77.7
ʌ	6	18	22	36	13	95	75.0	69.2	78.6	97.3	92.8	82.6
ə	8	25	26	35	13	107	100.0	96.2	92.8	94.6	92.8	95.3
Diphthongs												
aɪ	3	18	20	32	10	83	30.0	66.7	55.6	88.9	100.0	68.2
aʊ	7	19	19	26	8	79	70.0	70.4	52.8	72.2	80.0	69.1
ɔɪ	6	20	25	31	10	92	60.0	74.1	69.4	86.1	100.0	77.9
ju	1	13	23	28	10	75	10.0	48.1	63.9	77.8	100.0	59.9

age given for each sound is based on the total number of children tested on that sound (Group A).

Age, Years	Sounds Given Correctly by 75 per cent or More of the Children
	Consonant Elements
2	p–, –p–, b–, –b–, t–, d–, m–, –m–, n–, –n–, w–, –w–, h
3	p–, –p–, b–, –b–, –b, t–, –t, d–, –d–, k–, –k–, g–, –g–, m–, –m–, –m, n–, –n–, –n, –ŋ–, w–, –w–, f–, –f–, –f, –z–, –z, h

4 p–, –p–, –p, b–, –b–, –b, t–, –t, d–, –d, k–, –k–, –k, g–, –g–, –g, m–, –m–, –m, n–, –n–, –n, –ŋ–, w–, –w–, f–, –f–, –f, –v, –z–, –z, –tʃ, dʒ–, –dʒ–, l–, –l–, –l, –r–, –ɹ, j–, –j–, h

5 p–, –p–, –p, b–, –b–, –b, t–, –t–, –t, d–, –d–, –d, k–, –k–, –k, g–, –g– –g, m–, –m–, –m, n–, –n–, –n, –ŋ–, m–, –w–, f–, –f–, –f, v–, –v–, –v, ɵ–, ð–, –ð–, s–, –s–, –s, z–, –z–, –z, ʃ–, –ʃ–, –ʃ, ʒ, tʃ–, –tʃ–, –tʃ, dʒ–, –dʒ–, l–, –l–, –l, r–, –r–, –ɹ, j–, –j–, h

TABLE 7

Number and Percentage of Children Giving Sounds Correctly

Sound	Group C											
	Children Completely Tested on Four Sound Groups											
	Number Giving Sound Correctly						Per Cent Giving Sound Correctly					
	Age, Years					Total	Age, Years					Mean
	2	3	4	5	6		2	3	4	5	6	
Consonant Elements												
p-	6	16	14	18	2	56	100.0	100.0	93.3	100.0	100.0	98.7
-p-	5	16	14	18	2	55	83.3	100.0	93.3	100.0	100.0	95.3
-p	3	11	12	18	2	46	50.0	68.7	80.0	100.0	100.0	79.7
b-	6	16	12	18	2	54	100.0	100.0	80.0	100.0	100.0	96.0
-b-	6	16	13	18	2	55	100.0	100.0	86.7	100.0	100.0	97.3
-b	2	13	12	15	2	44	33.3	81.3	80.0	83.3	100.0	87.6
t-	6	16	15	17	2	56	100.0	100.0	100.0	94.4	100.0	98.9
-t-	3	10	11	14	2	40	50.0	62,5	73.3	77.8	100.0	72.7
-t	2	12	12	17	2	45	33.3	75.0	80.0	94.4	100.0	76.5
d-	5	16	14	18	2	55	83.3	100.0	93.3	100.0	100.0	95.3
-d-	5	12	9	17	2	45	83.3	75.0	60.0	94.4	100.0	82.5
-d	2	15	14	18	2	51	33.3	93.8	93.3	100.0	100.0	84.1
k-	5	11	9	16	2	43	83.3	68.7	60.0	88.9	100.0	80.2
-k-	5	13	14	18	2	52	83.3	81.3	93.3	100.0	100.0	91.6
-k	2	13	10	18	2	45	33.3	81.3	66.7	100.0	100.0	76.3
g-	3	13	12	17	2	47	50.0	81.3	80.0	94.4	100.0	81.1
-g-	5	14	14	17	2	52	83.3	87.5	93.3	94.4	100.0	91.7
-g	2	11	13	17	2	45	33.3	68.7	86.7	94.4	100.0	76.6
m-	6	15	13	18	2	54	100.0	93.8	86.7	100.0	100.0	96.1
-m-	6	16	13	18	2	55	100.0	100.0	86.7	100.0	100.0	97.3
-m	4	15	14	18	2	53	66.7	93.8	93.3	100.0	100.0	90.8
n-	6	15	13	18	2	54	100.0	93.8	86.7	100.0	100.0	96.1
-n-	6	15	14	17	2	54	100.0	93.8	93.3	94.4	100.0	96.3
-n	3	15	13	18	2	51	50.0	93.8	86.7	100.0	100.0	86.1
-ŋ	2	6	8	6	2	24	33.3	37.5	53.3	33.3	100.0	51.5
w-	2	12	7	16	2	39	33.3	75.0	46.7	88.9	100.0	68.8
-w-	5	14	14	18	2	53	83.3	87.5	93.3	100.0	100.0	94.8
f-	2	13	13	18	2	48	33.3	81.3	86.7	100.0	100.0	96.5
-f-	1	15	15	18	2	51	16.7	93.8	100.0	100.0	100.0	82.1
-f	2	15	12	16	2	47	33.3	93.8	80.0	88.9	100.0	79.2
v-	0	8	8	14	2	32	0.0	50.0	53.0	77.8	100.0	56.2
-v-	0	12	8	16	2	38	0.0	75.0	53.3	88.9	100.0	63.4
-v	0	10	11	16	2	39	0.0	62.5	73.3	88.9	100.0	64.9
ɵ-	1	6	7	12	2	28	16.7	37.5	46.7	66.7	100.0	53.5
-ɵ-	0	7	6	15	2	30	0.0	43.8	40.0	83.3	100.0	53.2
-ɵ	0	4	7	12	2	25	0.0	25.0	46.7	66.7	100.0	47.7
ð-	0	6	9	12	2	29	0.0	37.5	60.0	66.7	100.0	52.8
-ð-	0	7	8	16	2	33	0.0	43.8	53.3	88.9	100.0	57.2
-ð	0	1	1	2	1	5	0.0	6.3	6.7	11.1	50.0	14.8
s-	1	10	10	15	2	38	16.7	62.5	66.7	83.3	100.0	65.8
-s-	1	12	10	14	2	39	16.7	75.0	66.7	77.8	100.0	67.2
-s	2	9	9	13	2	35	33.3	56.3	60.0	72.2	100.0	64.4
z-	0	10	8	13	2	43	0.0	62.5	53.3	72.2	100.0	57.4
-z-	0	12	12	16	2	42	0.0	75.0	80.0	88.9	100.0	68.8
-z	1	12	11	14	2	40	16.7	75.0	73.3	77.8	100.0	68.6

6 p–, –p–, –p, b–, –b–, t–, –t, d–, –d–, –d, k–, –k–, –k, g–, –g–, –g, m–, –m–, –m, n–, –n–, –n, –ŋ–, w–, –w–, f–, –f–, –f, –v–, –v, ɵ–, ð–, –ð–, –s–, –s, z–, –z–, –z, ʃ–, –ʃ–, –ʃ, ʒ, tʃ–, –tʃ–, –tʃ, dʒ–, –dʒ–, –dʒ, l–, –l–, –l, r–, –r–, –ɹ, j–, –j–, h

Consonant Blends

2 None

TABLE 7 (Continued)

Number and Percentage of Children Giving Sounds Correctly

Sound	Group C: Children Completely Tested on Four Sound Groups — Number Giving Sound Correctly: Age, Years 2	3	4	5	6	Total	Per Cent Giving Sound Correctly: Age, Years 2	3	4	5	6	Mean
Consonant Elements												
f-	0	8	11	18	2	39	0.0	50.0	73.3	100.0	100.0	64.7
-f-	0	8	10	17	2	37	0.0	50.0	66.7	94.4	100.0	62.2
-f	0	4	8	17	2	31	0.0	25.0	53.3	94.4	100.0	54.5
ʒ	1	10	9	15	2	37	16.7	62.5	60.0	83.3	100.0	64.5
tʃ-	1	9	10	17	2	39	16.7	56.3	66.7	94.4	100.0	66.8
-tʃ-	2	10	9	18	2	41	33.3	62.5	60.0	100.0	100.0	71.2
-tʃ	0	11	8	17	2	38	0.0	68.7	53.3	94.4	100.0	63.3
dʒ-	1	13	11	16	2	43	16.7	81.3	73.3	88.9	100.0	72.0
l-	2	10	7	17	2	38	33.3	62.5	46.7	94.4	100.0	67.4
-l-	2	13	10	17	2	44	33.3	81.3	66.7	94.4	100.0	75.1
-l	0	8	9	15	2	34	0.0	50.0	60.0	83.3	100.0	58.6
r-	2	7	8	16	2	35	33.3	43.8	53.3	88.9	100.0	63.9
-r-	0	7	13	15	2	37	0.0	43.8	86.7	83.3	100.0	62.8
-ɹ	1	7	10	17	2	37	16.7	43.8	66.7	94.4	100.0	64.3
-j-	1	11	12	17	2	43	16.7	68.7	80.0	94.4	100.0	72.0
h	5	16	14	18	2	55	83.3	100.0	93.3	100.0	100.0	95.3
Consonant Blends												
mp	1	15	14	18	2	50	16.7	93.8	93.3	100.0	100.0	80.8
mz	1	10	10	14	2	37	16.7	62.5	66.7	77.8	100.0	64.5
nt	2	12	9	14	2	39	33.3	75.0	60.0	77.8	100.0	69.2
nd	0	5	8	14	1	28	0.0	31.3	53.3	77.8	50.0	42.5
ns	1	11	10	17	2	41	16.7	68.8	66.7	94.4	100.0	69.3
nz	1	11	11	18	2	43	16.7	68.8	73.3	100.0	100.0	71.8
ŋk	3	13	14	18	2	50	50.0	81.3	93.3	100.0	100.0	84.9
ŋg	1	10	10	15	2	38	16.7	62.5	66.7	83.3	100.0	65.8
ŋz	2	12	11	15	2	42	33.3	75.0	73.3	83.3	100.0	73.0
sp	1	9	9	17	2	38	16.7	56.3	60.0	94.4	100.0	65.5
st-	1	9	9	15	2	36	16.7	56.3	60.0	83.3	100.0	63.3
-st	0	8	7	10	2	27	0.0	50.0	46.7	55.6	100.0	50.5
sk	1	9	8	15	2	35	16.7	56.3	53.3	83.3	100.0	61.9
sm	1	10	8	16	2	37	16.7	62.5	53.3	88.9	100.0	64.3
sn	1	6	11	15	2	35	16.7	37.5	73.3	83.3	100.0	62.2
sw-	1	9	9	14	2	35	16.7	56.3	60.0	77.8	100.0	62.2
sl	0	7	7	13	2	29	0.0	43.8	46.7	72.2	100.0	52.5
spr-	1	6	8	16	2	33	16.7	37.5	53.3	88.9	100.0	59.3
str-	1	6	11	16	2	36	16.7	37.5	73.3	88.9	100.0	63.1
skr-	0	4	5	15	2	26	0.0	25.0	33.3	83.3	100.0	48.3
spl-	0	4	7	16	2	29	0.0	25.0	46.7	88.9	100.0	52.1
skw-	0	5	9	14	2	30	0.0	31.3	60.0	77.8	100.0	53.8
-ps	0	13	11	18	2	44	0.0	81.3	73.3	100.0	100.0	70.9
-ts	1	12	11	15	2	41	16.7	75.0	73.3	83.3	100.0	69.7

TABLE 7 (Continued)

Number and Percentage of Children Giving Sounds Correctly

Sound	Group C — Children Completely Tested on Four Sound Groups											
	Number Giving Sound Correctly						Per Cent Giving Sound Correctly					
	Age, Years					Total	Age, Years					Mean
	2	3	4	5	6		2	3	4	5	6	
Consonant Blends												
ks	1	11	11	17	2	42	16.7	68.8	73.3	94.4	100.0	70.6
-dz	1	4	11	18	2	36	16.7	25.0	73.3	100.0	100.0	63.0
-gz	2	8	11	15	2	38	33.3	50.0	73.3	83.3	100.0	68.0
-lz	0	11	10	15	2	38	0.0	68.8	66.7	83.3	100.0	63.8
pr	1	7	9	16	2	35	16.7	43.8	60.0	88.9	100.0	61.9
br	1	6	8	15	2	32	16.7	37.5	53.3	83.3	100.0	58.2
tr	1	11	9	17	2	40	16.7	68.8	60.0	94.4	100.0	68.0
dr	0	10	12	17	2	41	0.0	62.5	80.0	94.4	100.0	67.4
kr	1	7	10	15	2	35	16.7	43.8	66.7	83.3	100.0	62.1
gr	1	11	10	16	2	40	16.7	68.8	66.7	88.9	100.0	68.2
fr	1	6	7	16	2	32	16.7	37.5	46.7	88.9	100.0	68.0
θr	0	2	3	12	2	19	0.0	12.5	20.0	66.7	100.0	39.8
lk	0	4	7	14	2	27	0.0	25.0	46.7	77.8	100.0	49.9
lf	0	5	11	15	2	33	0.0	31.3	73.3	83.3	100.0	57.6
lv	1	11	7	17	2	38	16.7	68.8	46.7	94.4	100.0	65.3
ld	0	6	8	13	2	29	0.0	37.5	53.3	72.2	100.0	52.6
pl	0	7	8	17	2	34	0.0	43.8	53.3	94.4	100.0	58.3
bl	0	7	9	15	2	33	0.0	43.8	60.0	83.3	100.0	57.4
fl	0	6	8	16	2	32	0.0	37.5	53.3	88.9	100.0	55.9
kl	0	10	9	17	2	38	0.0	62.5	60.0	94.4	100.0	63.4
gl	0	9	8	18	2	37	0.0	56.3	53.3	100.0	100.0	61.9
tw	2	11	10	18	2	43	33.3	68.8	66.7	100.0	100.0	73.8
kw	0	13	11	18	2	44	0.0	81.3	73.3	100.0	100.0	70.9
Vowels												
i	6	15	14	18	2	55	100.0	93.8	93.3	100.0	100.0	97.4
ɪ	3	8	11	13	2	37	50.0	50.0	73.3	72.2	100.0	69.1
e	2	9	9	13	2	35	33.3	56.3	60.0	72.2	100.0	64.4
ɛ	4	10	12	14	2	42	66.7	62.5	80.0	77.8	100.0	77.4
æ	2	10	8	13	1	34	33.3	62.5	53.3	72.2	50.0	54.1
ɑ	6	14	13	17	2	52	100.0	87.5	86.7	94.4	100.0	95.7
ʊ	5	16	13	17	2	53	83.3	100.0	86.7	94.4	100.0	92.9
o	4	13	11	17	1	46	66.7	81.3	73.3	94.4	50.0	73.1
ɔ:	3	11	14	18	1	47	50.0	68.8	93.3	100.0	50.0	72.4
ʌ	5	13	12	18	2	50	83.3	81.3	80.0	100.0	100.0	88.9
ə	6	15	13	17	2	53	100.0	93.8	86.7	94.4	100.0	95.0
Diphthongs												
aɪ	2	13	11	14	2	42	33.3	81.3	73.3	77.8	100.0	73.1
aʊ	5	12	12	14	2	45	83.3	75.0	80.0	77.8	100.0	83.2
ɔɪ	5	15	12	18	2	52	83.3	93.8	80.0	100.0	100.0	91.4
ju	1	11	15	16	2	45	16.7	68.8	100.0	88.9	100.0	74.9

3 mp

4 mp, nt, ŋk, kw

5 mp, mz, nt, ns, nz, ŋk, ŋg, ŋz, sp, st–, sk, sm, sn, sw–, sl, spr–, str–, skr–, skw–, –ps, –ts, ks, –dz, –gz, –lz, pr, br, tr, dr, kr, gr, fr, lf, lv, pl, bl, fl, kl, gl, tw, kw

TABLE 8

Ranking of Sounds Within Sound Groups by Ages based on Percentages of Children Giving Sounds Correctly

Group B																							
Children Completely Tested on One Sound Group																							
	Consonant Elements							Consonant Blends								Vowels							
	Age, Years							Age, Years								Age, Years							
Sound	2	3	4	5	6	All Ages	Sound	2	3	4	5	6	All Ages	Sound	2	3	4	5	6	All Ages			
p-	2.5	7.0	7.5	11.0	10.0	4.0	mp	17.5	1.0	1.5	10.0	43.0	4.0	i	1.5	1.0	1.0	4.5	1.5	1.0			
-p-	10.0	2.5	12.5	11.0	24.5	10.0	mz	17.5	12.5	16.0	43.0	20.0	20.0	ɪ	8.5	10.0	10.0	11.0	10.0	9.0			
-p	20.5	14.0	23.5	49.5	24.5	22.0	nt	4.0	5.5	22.5	38.5	20.0	10.0	e	10.5	7.0	7.5	8.0	7.5	7.0			
b-	6.0	11.0	17.5	11.0	10.0	7.0	nd	33.0	37.0	31.0	38.5	47.0	44.5	ɛ	7.0	8.0	9.0	9.0	11.0	8.0			
-b-	6.0	7.0	17.5	11.0	10.0	6.0	ns	17.5	8.0	16.0	10.0	20.0	10.0	æ	10.5	9.0	11.0	10.0	9.0	10.0			
-b	25.5	25.0	29.5	39.0	56.0	30.0	nz	17.5	12.5	9.0	10.0	43.0	20.0	ɑ	5.0	4.0	3.0	7.0	4.5	3.0			
t-	14.5	25.0	2.5	11.0	10.0	14.5	ŋk	1.0	3.0	1.5	10.0	20.0	6.5	ʊ	3.0	11.0	4.0	2.5	1.5	11.0			
-t-	39.5	42.0	44.0	57.0	56.0	51.5	ŋz	17.5	19.0	16.0	20.5	20.0	18.0	o	5.0	3.0	5.5	6.0	4.5	4.0			
-t	32.5	37.5	26.5	45.5	56.0	35.0	ts	4.0	5.5	16.0	30.0	20.0	6.5	ɔ	8.5	5.0	5.5	1.0	7.5	6.0			
d-	6.0	2.5	7.5	11.0	10.0	5.0	sp	17.5	19.0	16.0	10.0	20.0	15.5	ʌ	5.0	6.0	7.5	2.5	4.5	5.0			
-d-	18.0	32.0	39.0	32.0	10.0	23.0	st-	17.5	24.5	22.5	30.0	20.0	22.5	ə	1.5	2.0	2.0	4.5	4.5	2.0			
-d	25.5	16.5	29.5	25.0	41.5	26.0	-st	38.0	28.0	44.5	47.0	43.0	46.0										
k-	14.5	20.0	23.5	25.0	10.0	17.0	sk	17.5	24.5	40.5	30.0	20.0	27.0										
-k-	18.0	20.0	7.5	25.0	24.5	18.5	sm	17.5	19.0	31.0	20.5	20.0	15.5										
-k	25.5	20.0	29.5	11.0	41.5	10.0	sn	17.5	37.0	16.0	30.0	20.0	34.5										
g-	18.0	25.0	12.5	11.0	24.5	20.5	sw-	17.5	19.0	40.5	38.5	20.0	27.0										
-g-	10.0	14.0	7.5	11.0	24.5	12.0	sl	38.0	31.5	44.5	38.5	20.0	39.0										
-g	20.5	25.0	17.5	25.0	49.5	24.5	spr-	17.5	37.0	31.0	30.0	20.0	34.5										
m-	2.5	7.0	2.5	11.0	10.0	2.0	str-	17.5	37.0	31.0	20.5	20.0	31.0										
-m-	2.5	2.5	2.5	11.0	10.0	2.0	skr-	38.0	44.5	46.0	20.5	43.0	43.0										
-m	10.0	7.0	12.5	11.0	10.0	8.0	spl-	38.0	44.5	40.5	30.0	20.0	40.5										
n-	2.5	7.0	2.5	11.0	10.0	2.0	skw-	38.0	41.5	31.0	43.0	20.0	40.5										
-n-	10.0	11.0	17.5	11.0	24.5	13.0	-ps	38.0	3.0	16.0	10.0	20.0	1.0										
-n	25.5	11.0	17.5	11.0	10.0	20.5	-ts	4.0	8.0	9.0	30.0	20.0	6.5										
-ŋ	32.5	57.0	59.5	61.0	56.0	60.0	ks	17.5	12.5	9.0	10.0	20.0	10.0										
M-	39.5	37.5	47.5	32.0	49.5	43.0	-dz	17.5	44.5	5.5	10.0	20.0	22.5										
W-	10.0	20.0	7.5	45.5	10.0	14.5	-gz	4.0	24.5	9.0	30.0	20.0	12.5										
f-	14.5	20.0	17.5	11.0	10.0	16.0	-lz	38.0	12.5	9.0	30.0	20.0	20.0										

-f-	25.5	14.0	7.5	11.0	10.0	18.5	pr	17.5	31.5	31.0	20.5	3.0	37.0
-f	25.5	16.5	21.0	32.0	41.5	24.5	br	17.5	37.0	31.0	30.0	20.0	34.5
v-	58.0	46.0	39.0	45.5	60.0	53.5	tr	17.5	12.5	22.5	10.0	20.0	15.5
-v-	58.0	34.5	53.0	32.0	24.5	46.0	dr	38.0	19.0	5.5	10.0	20.0	15.5
-v	49.0	42.0	39.0	39.0	24.5	38.5	kr	17.5	31.5	16.0	30.0	20.0	24.5
θ-	58.0	57.0	57.0	58.5	41.5	58.0	gr	17.5	12.5	16.0	20.5	20.0	12.5
-θ-	49.0	49.5	59.5	55.5	41.5	55.0	fr	17.5	37.0	31.0	10.0	20.0	29.0
-θ	49.0	60.0	57.0	55.5	41.5	58.0	θr	38.0	47.0	47.0	46.0	20.0	47.0
ð-	58.0	57.0	53.0	58.5	49.5	58.0	lk	38.0	44.5	40.5	43.0	43.0	44.5
-ð-	58.0	49.5	39.0	49.5	41.5	51.5	lf	38.0	41.5	3.5	38.5	20.0	31.0
-ð	58.0	61.0	61.0	60.0	61.0	61.0	lv	38.0	19.0	31.0	20.5	20.0	27.0
s-	39.5	42.0	50.5	51.5	49.5	49.0	ld	38.0	31.5	31.0	45.0	43.0	42.0
-s-	32.5	28.5	53.0	51.5	49.5	38.5	pl	38.0	28.0	40.5	10.0	20.0	31.0
-s	25.5	34.5	57.0	53.0	56.0	47.0	bl	38.0	28.0	22.5	38.5	20.0	34.5
z-	49.0	37.5	47.5	45.5	24.5	43.0	fl	38.0	37.0	40.5	20.5	20.0	38.0
-z-	39.5	25.0	26.5	11.0	24.5	27.5	kl	38.0	19.0	31.0	10.0	20.0	5.0
-z	39.5	30.0	29.5	39.0	10.0	29.0	gl	38.0	24.5	31.0	2.0	20.0	24.5
ʃ-	39.5	49.5	33.5	25.0	41.5	38.5	tw	4.0	8.0	31.0	2.0	20.0	8.0
-ʃ-	49.0	49.5	47.5	32.0	10.0	43.0	kw	17.5	3.0	3.5	2.0	20.0	3.0
-ʃ	58.0	59.0	50.5	11.0	10.0	49.0							
ʒ	49.0	54.0	39.0	39.0	41.5	49.0							
tʃ-	49.0	42.0	39.0	11.0	41.5	38.5							
-tʃ-	49.0	42.0	44.0	39.0	33.0	53.5							
-tʃ	49.0	37.5	44.0	25.0	33.0	35.0							
dʒ-	32.5	32.0	23.5	45.5	49.5	31.0							
l-	25.5	32.0	33.5	25.5	33.0	27.5							
-l-	39.5	28.5	23.5	39.0	56.0	33.0							
-l	49.0	49.5	55.0	54.0	56.0	56.0							
r-	32.5	54.0	47.5	45.5	33.0	43.0							
-r-	49.0	49.5	33.5	32.0	33.0	43.0							
-ɹ	32.5	49.5	33.5	32.0	33.0	32.0							
j-	39.5	45.0	39.0	39.0	33.0	35.0							
h	14.5	2.5	12.5	11.0	10.0	10.0							

6 mp, mz, nd, ns, nz, ŋk, ŋg, sp, st–, sk, sw–, sl, str–, skr–, skw–, –ps, –ts, ks, –lz, br, tr, dr, kr, gr, fr, ər, lv, pl, bl, fl, kl, gl, tw, kw

Vowels

2 i, ɑ, u, o, ɵ, ʌ, ə

3 i, ɛ, ɛ:, ɑ, u, o, ɔ:, ɵ, ʌ, ə,

4 i, I, e, æ, ɑ, u, U, o, ɔ:, ɔ, ʌ, ə

5 i, I, e, ɛ, ɛ:, æ, ɑ, u, U, o, ɔ:, ɔ, ɵ, ʌ, ə,

6 i, I, e, ɛ, ɛ:, æ, ɑ, u, U, o, ɔ:, ɔ, ɵ, ʌ, ə,

Diphthongs

2 None

3 aI, ɑU, ɔI, ju

4 aI, ɑU, ɔI, ju

5 aI, ɑU, ɔI, ju

6 aI, ɑU, ɔI

Relative Ranking of Sounds

Comparison of age groups for the relative standing of a given sound may be made from Table 8, in which the sounds are ranked within sound groups according to the percentages of children of Group B giving them correctly. The ranks for consonant elements vary from 1 to 61, for consonant blends from 1 to 47, and for vowels from 1 to 11. There was considerable variation in the ranks of a given sound at the various age levels, the widest differences between age groups varying from 3 to 49.

For –ʃ there was a variation of 49 ranks, for –ʃ– 39.5 ranks, and for *t*ʃ– and *w*– 38 ranks. Consistent ranking through the age groups seemed to be the exception rather than the rule. This may mean (1) merely that although there was a general tendency for sounds to become easier as age progressed, the specific sounds did not become easier in the same degree, (2) that not sufficient children were tested at the different age levels for stability of ranking, or (3) that more stability might have been obtained had the same children instead of different children been tested at consecutive years. The degree of stability is indicated in the correlations given in Table 11. For a few consonant elements

the rankings were fairly consistent for the different ages. The consonant elements that ranked consistently high were:

Sound	Rank
–m,	7.0 to 12.5
n–, –m–, m–, d– and p–	2.5 to 11.0

The sounds that ranked consistently low were:

Sound	Rank
–ð,	58.0 to 61.0
–l,	49.0 to 56.0
ð–,	49.5 to 58.5

For *l*— the ranks varied only from 25.5 to 33.5.

The rankings in Group A of the five consonant elements omitted in Group B were as follows:

Sound	Age, Years					All
	2	3	4	5	6	Ages
–ŋ–	21.0	12.5	10.5	28.0	65.0	21.5
–w–	13.0	24.0	17.5	51.0	54.0	24.0
–dʒ–	48.5	53.0	29.0	55.5	40.0	45.5
–dʒ	54.0	62.0	48.5	64.0	28.0	59.0
–j–	63.5	39.0	26.5	22.5	54.0	28.5

It will be noted that there is a wide variation in the ranks of these sounds in the various age groups, the widest differences varying from 26 to 54.5.

The consonant blends that were most consistent in their rankings were:

Sound	Rank
sp	10.0 to 20.0
gr	12.5 to 20.5
ŋg	16.0 to 20.5
lk	38.0 to 44.5

In Table 9 is given the distribution of differences in rank between adjacent age groups for consonant elements and consonant blends. Of the sixty-one consonant elements, from twenty-one to twenty-six varied not more than four points in rank from one age to the next; more than two-thirds of the sounds differed less than ten points in rank from one age group to the next, except from five to six years. However, there was as great a variance as thirty-five points for two sounds between four and five years and for one sound between five and six years. There was greater consistency at the earlier ages than at the older ages; between two and three years fifty-eight of the sixty-one consonant elements

TABLE 9

Frequency of Differences in Rank of Sounds for Age Groups

Difference	Group B							
	Children Completely Tested on One Sound Group							
	Consonant Elements				Consonant Blends			
	Age Group, Years				Age Group, Years			
	2-3	3-4	4-5	5-6	2-3	3-4	4-5	5-6
0- 4	26	21	26	25	12	19	13	9
5- 9	19	20	18	9	15	7	8	1
10-14	13	12	3	10	7	10	12	22
15-19	1	5	8	8	9	6	2	8
20-24	2	3	2	4	1	3	6	4
25-29	0	0	2	2	2	0	4	1
30-34	0	0	0	2	0	0	1	2
35-39	0	0	2	1	1	2	1	0

changed less than fifteen points in rank. For consonant blends there was less consistency than for consonant elements. Although the maximum possible difference was less for the blends, the actual differences were larger and there was a wide spread of differences at all ages.

The average rank and range of ranks for sound groups when 123 sounds are ranked regardless of classification, are given in Table 10. The ranks are based on the results for

TABLE 10

Mean Rank and Range of Ranks for Sound Groups Based on Percentages of Children Giving Sounds Correctly

Age, Years	Group C			
	Children Completely Tested on Four Sound Groups			
	Consonant Elements	Consonant Blends	Vowels	Diphthongs
	Mean Rank			
2	53.9	82.2	22.8	37.6
3	51.1	78.7	44.5	36.7
4	55.6	79.2	47.4	30.7
5	55.7	69.6	61.5	73.0
All Ages	53.1	95.4	46.2	32.1
	Range of Ranks			
2	6.0-106.0	30.0-106.0	6.0- 44.0	17.5- 71.5
3	5.0-118.5	15.5-122.0	5.0- 89.0	15.5- 56.0
4	3.0-123.0	11.0-122.0	4.0-100.5	2.0- 51.0
5	16.5-123.0	16.5-121.0	16.5-113.0	16.5-103.5
All Ages	1.5-123.0	25.5-122.0	4.0-107.5	19.0- 42.5

the fifty-seven children of Group C who were completely tested on all four sound groups. When all ages are taken together, it is found that the average rank is highest for the diphthong group and lowest for the consonant blend group. At two years of age vowels ranked highest and consonant blends lowest, at three and four years diphthongs ranked highest and consonant blends lowest, and at five years consonant elements ranked highest and diphthongs ranked lowest. There was not enough variation in the percentages of children passing various sounds to make ranking for the six year group valid. There was wide variation in the rankings within the sound groups, as will be seen by the range of ranks.

Correlations between Age Groups

The degree of consistency with which the sounds kept their relative positions in the different age groups is indicated by the correlations given in Table 11 between the percentages of children giving correctly each sound within the consonant element group, consonant blend group, and all sounds regardless of classification. There were too few vowels and diphthongs to permit reliable correlations for these groups separately. The correlations for consonant elements were

TABLE 11
Correlations Between Age Groups of Percentages of Children Giving Sounds Correctly

Age, Years	Group B: Children Completely Tested on One Sound Group; Age, Years			
	3	4	5	6
Consonant Elements				
2	.79±.03	.73±.04	.54±.06	.51±.06
3		.81±.03	.64±.05	.48±.07
4			.67±.05	.56±.06
5				.61±.05
Consonant Blends				
2	.50±.07	.45±.08	.28±.09	.24±.09
3		.59±.06	.41±.08	.14±.10
4			.43±.08	.14±.10
5				.28±.09
All Sounds				
2	.65±.04	.67±.03	.41±.05	.51±.05
3		.71±.03	.52±.04	.47±.05
4			.60±.04	.49±.05
5				.49±.05

significant and fairly high, ranging from .48 ± .07 between three and six years to .81 ± .03 between three and four years, indicating that the sounds tended to keep their same relative ranks at the different ages. The correlations were highest between the younger age groups; the lower correlations at the older ages may be explained by the fact that there was less range in the items at these ages. There was a tendency for the correlations at any age to run higher with adjacent age groups than with age groups further removed.

The correlations between age groups for consonant blends were lower than for consonant elements, indicating less tendency for specific sounds to keep their relative ranks at the different ages. Between the six year group and the other ages the correlations were insignificant or low. The correlations tended to be highest between the younger age groups and to be higher between adjacent age groups than between groups further apart.

When 123 sounds were included the correlations between age groups were significant and fairly high, ranging from .41 ± .05 to .71 ± .03, indicating that the various sounds tended to keep their relative order of difficulty. The correlations tended to run slightly lower than those for consonant elements alone. The correlations were again highest between the younger age groups.

Influence of Position on Difficulty

In the foregoing discussion when the same consonant element was tested in different locations or positions in words, initial, medial, or final, it has been considered as a separate sound in each position. In order to determine whether one position was more difficult than another, the numbers of children giving the consonant elements correctly in the different positions were compared. The means and standard deviations for the eighteen consonant elements (fifty-four sounds) on which Group B children were tested on the three positions are given in Table 12, with the ratios of the differences in the means to the standard deviations of the differences. Of the 120 children the average number giving the initial consonant elements correctly was 97.9, medial 94.8, and final 87.1. The means for each age group are also con-

TABLE 12

Mean Number of Children Giving Consonant Elements Correctly in Initial, Medial, and Final Position, Standard Deviation, Standard Deviation of Mean, and Ratio of Difference to Standard Deviation of Difference

Age, Years	Group B: Children Completely Tested on One Sound Group											
	Mean			Standard Deviation			Standard Deviation of Mean			Ratio of Difference to Standard Deviation of Difference		
	Initial	Medial	Final	Initial	Medial	Final	Initial	Medial	Final	Initial and Medial	Initial and Final	Medial and Final
18 Consonant Elements												
2	4.9	4.0	3.0	3.7	3.3	2.0	1.17	1.04	.63	.58	1.43	.82
3	20.5	20.2	17.0	6.1	3.8	6.9	1.15	.72	1.30	.22	2.02	2.16
4	28.3	28.2	26.1	4.9	5.0	5.8	.83	.84	.98	.09	1.72	1.63
5	34.7	33.5	32.2	3.7	3.0	4.8	.62	.50	.80	1.52	1.38	2.48
6	10.5	10.3	8.9	2.1	1.3	1.9	.63	.39	.57	.27	1.88	2.03
All Ages	97.9	94.8	87.1	18.3	15.6	19.0	1.67	1.42	1.73	1.42	4.50	3.44
Stops												
2	8.0	6.5	4.2	1.41	2.29	.66	.58	.93	.28	1.36	5.77	2.35
3	23.7	22.0	21.2	2.42	4.27	2.34	.99	1.74	.96	.65	1.82	.79
4	33.0	30.7	29.2	1.60	3.72	1.46	.65	1.52	.60	1.39	4.27	.92
5	35.8	33.8	33.7	.38	3.57	1.78	.16	1.46	.73	1.37	2.80	.06
6	10.8	9.8	8.3	.38	1.34	1.10	.16	.55	.45	1.75	5.21	2.11
All Ages	109.7	102.8	96.5	6.20	14.00	4.90	2.53	5.71	2.00	1.10	4.06	1.04
Nasals												
2	10.0	9.0	6.0	0.0	1.00	2.00	0.0	.71	1.42	1.25	2.82	1.84
3	26.0	26.0	25.5	0.0	1.00	.50	0.0	.71	.35	.71	1.39	.63
4	35.0	33.5	32.5	0.0	.14	.50	0.0	.10	.35	1.50	.71	.83
5	36.0	36.0	36.0	0.0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00
6	11.0	10.5	11.0	0.0	.50	0.00	0.0	.35	0.00	1.43	0.00	1.43
All Ages	118.0	115.0	111.0	0.0	4.2	3.00	0.0	2.98	2.13	1.01	3.29	1.09
Fricatives												
2	2.0	1.5	1.7	1.68	1.00	1.24	.50	.32	.39	.81	.46	.40
3	14.0	16.4	12.8	3.48	4.40	6.27	1.10	1.39	1.98	1.36	.53	1.49
4	25.1	25.7	22.9	3.08	3.88	6.39	.97	1.20	2.02	.39	.98	1.19
5	31.8	32.8	30.5	3.89	2.63	5.64	1.20	.83	1.78	.68	.60	1.17
6	9.0	9.5	8.8	1.34	1.20	2.08	.43	.38	.66	.88	.23	.92
All Ages	81.9	85.9	76.6	12.56	10.90	19.07	3.97	3.45	6.03	1.31	.73	1.34

sistently lowest on final sounds. For all ages combined, the ratios indicate that a true difference greater than zero existed between medial and final and initial and final positions, the ratios being 3.44 and 4.50 respectively but the ratio between initial and medial was only 1.42. None of the age groups showed a significant difference.

The consonant elements group is made up of three sub-groups, stops, nasals, and fricatives. The stops that occur in the three positions and on which Group B children were tested include *p*, *b*, *t*, *d*, *k*, and *g*; the nasals include *m* and *n*; and the fricatives include *f*, *v*, θ, ð, *s*, *z*, ʃ, ʧ, *l*, and *r*. The mean number of children

giving the initial stops correctly was 109.7, medial stops 102.8 and final stops 96.5. The ratio between initial and final stops indicated a true difference greater than zero. In each of the age groups the highest mean was on initial stops and the lowest on final stops. The ratios between initial and final positions were high, indicating that a true difference greater than zero existed except at three and five years; the ratio at five years was 2.80, indicating that a true difference was closely approximated. Between initial and medial positions the ratios were low, but tended to be higher than for all consonant elements. Between medial and final stops the ratios were low.

The mean number of children giving the initial nasals correctly was 118, medial nasals 115, and final nasals 111. The ratio between initial and final nasals indicates that a true difference existed. In every age group except six years the highest mean was on initial sounds and the lowest on final sounds. The ratio between initial and final nasals at two years was 2.82 indicating that a true difference was approximated. The ratios between initial and medial and between medial and final were low.

The mean number of children of all ages giving initial fricatives correctly was 81.9, medial fricatives 85.9, and final fricatives 76.6. The fricatives formed an exception to the general trend of higher means on initial sounds; the highest means on fricatives, except at two years, were on medial sounds and the lowest on final sounds. None of the differences was statistically significant, the ratios ranging from .25 to 1.49.

The respective ranks for initial, medial, and final positions for each sound are given in Table 13. Initial sounds most often ranked first, with the second and third ranks about equal in frequency; medial positions most often ranked second, with about an equal division of first and third ranks; final positions most often ranked third, with second rank next in frequency and the first rank less frequent.

There was no consistent tendency for any given combination of ranks to hold through the various age groups for a given sound; if the initial position of a sound ranked first in a given age group, it might or might not rank first in the other age groups.

The mean numbers of children giving the stops, nasals

TABLE 13

Comparative Ranks of Consonant Elements According to Initial, Medial, and Final Position in Word

Sound	Group A — All Children — Consonant Elements — Age, Years																		
	2			3			4			5			6			All Ages			
	Initial	Medial	Final	Initial	Medial	Final	Initial	Medial	Final	Initial	Medial	Final	Initial	Medial	Final	Initial	Medial	Final	
p	1.0	2.0	3.0	2.0	1.0	3.0	2.0	1.0	3.0	1.0	3.0	2.0	1.0	3.0	2.0	1.0	2.0	3.0	
b	1.0	2.0	3.0	2.0	1.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0	1.0	2.0	3.0	1.0	2.0	3.0	
t	1.0	3.0	2.0	1.0	3.0	2.0	1.0	2.0	3.0	1.0	3.0	2.0	1.0	3.0	2.0	1.0	3.0	2.0	
d	1.0	2.0	3.0	1.0	2.0	3.0	1.0	3.0	2.0	1.0	2.0	3.0	1.0	2.5	2.5	1.0	2.0	3.0	
k	1.0	2.0	3.0	2.0	1.0	3.0	2.0	1.0	3.0	1.0	3.0	2.0	1.0	2.0	3.0	1.0	2.0	3.0	
g	2.0	1.0	3.0	2.0	1.0	3.0	1.0	2.5	2.5	2.0	1.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0	
m	1.5	1.5	3.0	1.0	2.0	3.0	1.5	1.5	3.0	1.0	2.5	2.5	2.0	2.0	2.0	1.0	2.0	3.0	
n	1.0	2.0	3.0	1.0	2.0	3.0	1.0	3.0	2.0	2.0	3.0	1.0	3.0	2.0	1.0	1.0	2.0	3.0	
f	1.0	3.0	2.0	2.5	1.0	2.5	2.0	1.0	3.0	1.0	2.5	2.5	1.0	2.0	3.0	1.0	2.0	3.0	
v	3.0	2.0	1.0	3.0	1.0	2.0	3.0	1.0	2.0	2.0	3.0	1.0	3.0	2.0	1.0	3.0	2.0	1.0	
θ	1.0	2.5	2.5	3.0	1.5	1.5	3.0	1.5	1.5	1.0	2.5	2.5	1.0	2.5	2.5	1.0	2.5	2.5	
s	1.0	2.5	2.5	2.0	1.0	3.0	3.0	1.0	2.0	2.0	1.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0	
z	3.0	2.0	1.0	3.0	1.0	2.0	3.0	1.0	2.0	2.0	1.0	3.0	3.0	1.0	2.0	3.0	1.0	2.0	
ʃ	3.0	2.0	1.0	3.0	2.0	1.0	3.0	1.0	2.0	2.0	1.0	3.0	3.0	2.0	1.0	3.0	1.0	2.0	
ʧ	2.0	3.0	1.0	2.0	1.0	3.0	2.0	1.0	3.0	2.0	1.0	3.0	3.0	2.0	1.0	1.0	2.0	3.0	
l	1.0	2.5	2.5	1.0	2.5	2.5	1.5	3.0	1.5	2.0	3.0	1.0	2.0	2.0	2.0	2.0	3.0	1.0	
r	1.0	2.0	3.0	3.0	1.0	2.0	3.0	2.0	1.0	3.0	2.0	1.0	3.0	2.0	1.0	3.0	2.0	1.0	
	1.0	3.0	2.0	2.0	3.0	1.0	3.0	2.0	1.0	1.0	3.0	2.0	3.0	1.5	1.5	2.0	3.0	1.0	
Total	26.5	40.0	41.5	36.5	28.0	43.5	37.0	30.5	40.5	29.0	38.5	40.5	34.0	37.5	36.5	30.0	35.5	42.5	
Mean	1.5	2.2	2.3	2.0	1.6	2.4	2.1	1.7	2.3	1.6	2.1	2.3	1.8	2.0	2.0	1.7	1.9	2.3	

and fricatives correctly regardless of position were as follows:

Age, Years	Children	Stops	Nasals	Fricatives
2	10	6.2	8.3	1.7
3	28	22.3	25.8	14.4
4	35	30.9	33.7	24.6
5	36	34.4	36.0	31.7
6	11	9.7	10.8	9.1
All Ages	120	103.0	114.7	81.5

At every age a larger number of children gave the nasals correctly than the stops or fricatives, and a smaller number gave the fricatives correctly than either of the other groups.

Comparison of Voiced and Voiceless Sounds

The following consonant elements occurring in pairs differing in the amount of vocal cord vibrations, and each sound occurring in the three positions, may be classified as voiced and voiceless.

Voiced	Voiceless Counterparts
b	p
d	t
g	k
v	f
ð	θ
z	s

The mean numbers of children in Group B giving the voiced and voiceless sounds correctly at the different ages were as follows:

Age	Children	Voiced	Voiceless
2	10	3.7	4.3
3	28	18.3	18.9
4	35	27.2	27.7
5	36	32.7	32.1
6	11	9.2	9.3
All Ages	120	91.1	91.7

The differences between voiced and voiceless consonants were so small as to indicate that there were no real differences in difficulty as revealed by the number of children giving them correctly.

Types of Errors

Four types of errors were made on the various sounds: approximations or variations of the desired sound, substitution of another sound for the desired sound, inconsistency (giving the sound correctly at times and incorrectly at other

TABLE 14

Percentage of Errors Consisting of Approximations, Substitutions, Inconsistencies, and Omissions on Subdivisions of Consonant Elements and Consonant Blends

Age, Years	Group A											
	All Children											
	Approximations	Substitutions	Inconsistencies	Omissions	Approximations	Substitutions	Inconsistencies	Omissions	Approximations	Substitutions	Inconsistencies	Omissions
	Consonant Elements											
	All Consonant Elements				Stops				Nasals			
2	17	40	10	31	15	28	27	30	17	25	17	42
3	09	48	18	25	16	23	31	31	00	31	38	31
4	14	48	21	16	28	17	32	23	14	18	46	23
5	11	48	29	12	28	14	28	30	00	25	50	25
6	19	34	33	14	49	00	33	28	00	50	50	00
	Fricatives											
2	21	41	08	30								
3	09	53	13	25								
4	12	55	16	16								
5	10	54	27	09								
6	11	42	31	16								
	Consonant Blends											
	All Consonant Blends				Nasal Blends				Initial S Blends			
2	06	84	01	09	13	72	04	11	02	93	00	05
3	12	75	09	04	15	65	15	05	07	87	06	00
4	12	70	16	02	34	49	17	00	11	81	08	00
5	22	65	12	01	27	58	15	00	31	54	15	00
6	23	47	30	00	17	66	17	00	00	00	00	00
	Three-Consonant Blends				Initial Blends with R				Final S and Z Blends			
2	00	100	00	00	02	98	00	00	08	67	05	20
3	02	98	00	00	01	87	12	00	37	48	09	06
4	05	95	00	00	01	74	25	00	27	65	08	00
5	25	69	00	06	00	95	05	00	50	50	00	00
6	100	00	00	00	00	50	50	00	00	00	00	00
	Final L Blends				Initial L Blends				tw and kw			
2	05	52	26	17	03	97	00	00	18	82	00	00
3	13	82	00	05	02	91	05	02	00	100	00	00
4	08	64	23	05	07	54	39	00	00	100	00	00
5	13	74	11	02	25	42	33	00	00	00	00	00
6	33	33	33	00	00	00	00	00	00	00	00	00

times), and omission or dropping of a sound. In Table 14 the percentages of errors that were made on the consonant element stops, nasals, and fricatives are given. Approximations constituted 15 per cent of the errors on stops at two years of age; the percentage increased from age to age until at six years 49 per cent of the errors on stops were approxima-

tions. On the nasals and fricatives the two year group had a higher percentage of approximations than the other age groups; for which the percentages varied from 0 to 14. Substitutions constituted 28 per cent of the errors on stops at two years of age the percentage decreasing with each age group until no substitutions were recorded at six years. The percentages of substitutions on nasals ranged from 18 to 50, and on fricatives from 41 to 55. Inconsistencies constituted from 27 per cent to 33 per cent of the errors on stops; they increased on nasals from 17 per cent at two years to 50 per cent at five and six years, and on fricatives from 8 per cent at two years to 31 per cent at six years. Omissions on stops constituted from 23 to 31 per cent of the errors; on nasals they decreased from 42 per cent at two years to none at six years; on the fricatives they decreased from 30 per cent at two years to 9 per cent at five years. On the fricatives the largest percentage of errors at every age group consisted of substitutions.

On all consonant elements, there was a larger percentage of substitutions at every age than other types of errors and fewer approximations, except at six years, where the percentage of omissions was slightly less than that of approximations. There was a tendency for the percentage of omissions to decrease with age and for the percentage of inconsistencies to increase with age.

Consonant blends may be subdivided into nasal blends, including nine blends, *mp, mz, nt, nd, ns, nz,* ŋ*k,* ŋ*g,* and ŋ*z*; initial s blends, including seven blends, *sp, st–, sk, sm, sn, sw–,* and *sl*; three-consonant blends, including five blends, *spr–, skr–, str–, spl–,* and *skw–*; initial blends with *r*, including eight blends, *pr, br, tr, dr, kr, gr, fr,* and ɵ*r*; final *s* and *z* blends, including six blends, *–ps, –ts, ks, –dz, gz,* and *–lz*; final *l* blends, including four blends, *lk, lf, lv,* and *ld*; initial *l* blends, including five blends, *pl, bl, fl, kl,* and *gl*; and the two blends *tw* and *kw*. Table 14 gives the percentages of errors for each of these subdivisions. In every division larger percentages of errors were substitutions than other types of error. At two, three, four, and five years of age the percentages of errors that were substitutions ranged from 42 to 100 on the various divisions, except

that no substitutions were recorded on *tw* and *kw* at five years. No substitutions were recorded at six years on initial *s* blends, three-consonant blends, final *s* and *z* blends, initial *l* blends, and *tw* and *kw*.

The percentages of approximations ran higher on nasal blends and final *s* and *z* blends than on the other divisions, but there was less than 35 per cent, except at six years on three-consonant blends and three and five years on final *s* and *z* blends. The percentages of errors that were inconsistencies ranged from 0 to 50 with most of the percentages below 25. The two year group showed a higher percentage of omissions than any of the other age groups; for the two year group the highest percentage of omissions (20) was on final *s* and *z* blends; the percentages for the other age groups ran from 0 to 6.

On all blends, the percentages of errors that were substitutions and omissions decreased with age, while the percentages that were approximations and inconsistencies increased with age. Substitutions constituted a much larger percentage of the errors on consonant blends than on consonant elements; omissions and inconsistencies constituted a smaller percentage.

The number of approximations, substitutions, inconsistencies, and omissions on each sound are given in Table 15. The total number of errors recorded for the different sounds varied from 0 to 128. No errors were recorded on —*m*— and *n*—.

Interrelations of Speech Sounds and Relation of Speech Ability to Other Traits

Interrelations of Speech Sounds

Interrelations of the number of sounds correct in the different speech sound groups by Group C, children who were completely tested on 123 sounds, are given in Table 16.

The only correlations that were more than three times their probable errors were between consonant blends and consonant elements at three years (.89 ± .04) and at five years (.68 ± .09); consonant elements and vowels at four years (.58 ± .12), and at five years (.65 ± .09); and consonant blends and vowels, and vowels and diphthongs at five years (.43 ± .13). These correlations indicate that the children of three and five years who ranked high on consonant elements tended

TABLE 15

Number of Approximations, Substitutions, Inconsistencies, and Omissions on Each Sound

Group A

All Children

Sound	Consonant Elements					Sound	Consonant Blends					Sound	Vowels					Sound	Diphthongs				
	Approximations	Substitutions	Inconsistencies	Omissions	Total Errors		Approximations	Substitutions	Inconsistencies	Omissions	Total Errors		Approximations	Substitutions	Inconsistencies	Omissions	Total Errors		Approximations	Substitutions	Inconsistencies	Omissions	Total Errors
p	0	3	2	0	5	mp	2	5	1	1	9	ɪ	0	4	3	0	7	aɪ	2	23	12	0	37
p-	0	3	1	3	7	mz	10	12	2	0	24	ɪ	1	44	29	1	75	aʊ	1	24	14	0	39
p	11	0	9	15	35	nt	9	9	8	3	29	e	0	30	21	0	51	ɔɪ	0	4	?	0	6
b	1	3	5	3	12	nd	1	31	7	3	42	æ	3	28	20	0	51	ju	0	16	3	0	19
b-	1	0	3	3	7	ns	4	9	0	1	14	æ	0	5	0	0	5						
b	17	1	4	7	29	nz	7	12	2	1	21	ɑ	11	40	34	0	85						
t	1	4	1	1	7	ŋk	0	9	2	0	11	ɑ	2	9	8	0	19						
t-	7	15	27	28	77	ŋg	1	19	1	0	21	ʌ	2	3	4	0	9						
t	15	5	17	15	52	ŋz	5	11	0	0	16	ʊ	0	9	2	0	11						
d	0	4	2	0	6	sp	2	20	1	0	23	o	3	12	8	0	23						
d-	4	2	13	18	37	st	0	26	3	0	29	ɔ:	0	14	10	0	24						
d	9	1	6	9	25	-st	6	28	8	2	44	ɔ	0	8	3	0	11						
k	7	9	10	0	26	sk	2	24	5	0	31	ə	0	30	13	2	45						
k-	1	6	7	6	20	sm	2	21	0	0	23	ʌ	1	12	11	1	25						
k	13	5	14	10	42	sn	7	18	0	0	25	ə	0	2	4	2	8						
g	2	13	7	0	22	sw	6	25	2	0	33												
g-	2	7	1	1	11	sl	2	32	2	0	36												
g	10	6	4	4	24	spr-	1	26	0	0	27												
ʒ	0	2	2	0	4	str-	0	26	0	0	26												
ʒ-	0	0	0	0	0	skr-	2	31	0	0	33												
ʒ	3	0	2	3	8	spl-	1	30	0	1	32												
ʧ	0	0	0	0	0	skw-	4	28	0	0	32												
ʧ-	1	6	10	6	23	-ps	4	12	2	0	18												
ʧ	1	6	7	7	21	-ts	7	12	1	1	21												
ŋ	0	5	1	2	8	ks	2	17	4	2	25												
ŋ	1	68	52	7	128	dz	4	20	1	2	27												
M	2	44	11	0	57	gz	11	10	0	1	22												

w-	1	8	3	2	14	lz	8	10	1	5	24										
-w-	0	2	1	4	7	pr	0	27	4	0	31										
f-	2	17	10	1	30	br	0	26	6	0	32										
-f-	3	2	0	5	10	tr	0	20	3	0	23										
-f	6	9	7	7	29	dr	1	19	1	0	21										
v-	3	31	5	3	42	kr	1	25	1	0	27										
-v-	8	16	12	14	50	gr	0	20	1	0	21										
-v	9	8	7	19	43	fr	0	25	2	0	27										
θ-	4	57	10	0	71	θr	1	32	10	0	43										
-θ-	1	38	12	23	74	lk	5	23	6	0	34										
-θ	5	46	9	8	68	lf	2	19	1	4	26										
ð-	1	54	27	17	99	lv	4	12	1	5	22										
-ð-	0	36	7	17	60	ld	8	17	1	6	32										
-ð	2	74	1	21	98	tl	1	48	7	2	58										
s-	15	39	8	2	64	pl	3	23	4	0	30										
-s-	11	31	8	4	54	bl	1	21	8	0	30										
-s	9	36	11	10	66	fl	1	25	4	0	30										
z-	12	15	2	9	38	kl	3	20	3	1	27										
-z-	6	11	2	5	24	gl	0	15	5	0	20										
-z	5	15	8	8	36	tw	1	15	0	0	16										
ʃ-	11	24	11	0	46	kw	1	9	0	0	10										
-ʃ-	7	25	6	4	42																
-ʃ	10	30	6	7	53																
ʒ	6	21	1	5	33																
tʃ-	12	23	9	0	44																
-tʃ-	6	25	4	5	40																
-tʃ	14	14	6	8	42																
dʒ-	2	30	11	3	46																
-dʒ-	2	15	5	3	25																
-dʒ	4	30	9	6	49																
l-	5	15	9	15	44																
-l-	4	12	10	19	45																
-l	8	13	15	34	70																
r-	6	32	9	4	51																
-r-	2	13	5	24	44																
-r	1	10	5	22	38																
j-	0	18	8	14	40																
-j-	0	2	2	13	17																
h	1	2	2	2	7																
Total	313	1117	501	515	2446		143	974	121	41	1278	23	250	170	6	449	3	67	31	0	101

TABLE 16

Intercorrelations of Speech Sound Groups in Terms of Number of Sounds Given Correctly

Sound Groups	Group C		
	Children Completely Tested on Four Sound Groups		
	Consonant Elements	Consonant Blends	Vowels
3 Years			
Consonant Blends	.89±.04		
Vowels	.41±.14	.30±.15	
Diphthongs	.36±.14	.20±.16	.39±.14
4 Years			
Consonant Blends	.31±.16		
Vowels	.56±.12	-.04±.17	
Diphthongs	.29±.16	.39±.15	.23±.16
5 Years			
Consonant Blends	.68±.09		
Vowels	.65±.09	.43±.13	
Diphthongs	.09±.16	-.03±.16	.43±.13

also to rank high on consonant blends and those of four and five years who ranked high on consonant elements tended to rank rather high on vowels.

Relation of Speech Ability to Other Traits

The relationship between the number of speech sounds correct and various other characteristics of the children is indicated by the correlations given in Table 17. A high relationship between age and the ability to give the sounds correctly is indicated by the correlation .80 ± .03. There was also a fairly high correlation of chronological age with consonant blends and consonant elements but only a low positive relationship with vowels, and none with diphthongs.

Between mental age on the Stanford revision of the Binet scale and the total number of sounds, there was also a fairly high relationship. There was a definite correlation of mental age with consonant blends and with consonant elements, but with vowels and diphthongs the correlations were less than three times their probable errors.

When mental age was held constant by means of partial correlations, the correlations with chronological age were reduced, but were still positive and significant for the total number of sounds, consonant blends, and consonant elements. When chronological age was held constant, there was no relationship between speech sounds and mental age, except for a very

slight positive relationship with diphthongs. The correlation between chronological age and mental age was .90 ± .02.

	Chronological Age Mental Age Constant	Mental Age Chronological Age Constant
Consonant elements	.31 ± .06	.07 ± .07
Consonant blends	.49 ± .07	—.05 ± .09
Vowels	.16 ± .07	—.02 ± .07
Diphthongs	.15 ± .08	.24 ± .08
Total number of sounds	.51 ± .07	—.01 ± .09

Introversion-extroversion ratings on the Marston scale by at least three raters for each child were available. The raters were in daily contact with the children and were graduate students

TABLE 17

Correlations of Number of Speech Sounds Correct with Other Traits

Trait	Group B								Group C	
	Children Completely Tested on One Sound Group								Children Completely Tested on Four Sound Groups	
	Consonant *Elements*		Consonant *Blends*		Vowels		Diphthongs		Total Number of Sounds	
	Children	Correlation	Children	Correlation	Children	Correlation	Children	Correlation	Children	Correlation
2 to 6 Years										
Chronological age	101	.58±.04	53	.71±.05	90	.25±.07	71	.10±.08	55	.80±.03
Mental age	101	.51±.05	53	.59±.06	90	.20±.07	71	.22±.08	55	.71±.04
Introversion-extroversion, boys	61	.25±.08	36	.00±.11	56	.13±.09	47	-.03±.10	35	.00±.11
Introversion-extroversion, girls	48	.13±.10	28	.04±.13	45	-.03±.10	43	.01±.10	21	.04±.15
Vocabulary	24	.17±.12			19	.38±.13				
Height	108	.49±.05	56	.65±.05	103	.30±.06	101	.23±.06	48	.59±.06
Sitting height	108	.42±.05	57	.56±.06	104	.25±.06	102	.23±.06	48	.50±.07
Weight, boys	58	.46±.07	34	.63±.07	61	.27±.08	56	.25±.08	30	.52±.09
Weight, girls	49	.37±.08	26	.57±.09	43	.23±.10	46	.26±.09	18	.72±.08
Weight-height index	108	.49±.05	57	.37±.08	103	.18±.06	101	.22±.06	48	.28±.09
Pelidisi	108	-.20±.06	57	-.15±.09	104	-.07±.07	101	-.04±.07	48	-.16±.09
Perforation	32	.53±.09	29	.40±.11	34	.19±.11	30	.19±.12	34	.52±.09
Tracing path	26	.23±.13	42	.65±.06	22	.36±.13	23	-.01±.14	36	.67±.06
Number older siblings	85	.00±.07	45	.00±.10	82	-.14±.07	78	.07±.08		
3 Years										
Number older siblings	19	.08±.15	12	.32±.17	18	-.12±.16	15	-.42±.14		
4 Years										
Height	34	-.29±.11	16	.08±.17					14	-.34±.16
Sitting height	35	-.26±.11	16	.14±.17					14	-.11±.18
Number older siblings	23	.10±.14	12	-.21±.19	20	-.12±.15	25	.09±.13		
5 Years										
Height	32	-.16±.12	18	-.18±.15					15	-.20±.17
Sitting height	32	-.09±.12	18	-.26±.15					15	-.26±.16
Number older siblings	27	.20±.12	16	.11±.17	28	.03±.13	27	.20±.13		

or staff members. It was thought that the more extrovertive children might practice speech more and that this practice might affect their accuracy of sound production. Since sex differences were found by Marston[1] in introversion-extroversion traits, correlations were computed separately for boys and girls. There was no correlation for either sex between the ratings and speech sounds, except for consonant elements for boys, where there was a slight positive relationship (.25 ± .08). The correlation between vocabulary scores on the Smith (34) test and consonant elements and vowels show little or no relationship between size of vocabulary as measured by this test and ability to produce speech sounds correctly.

Since physical size may give some indication of maturity other than can be obtained through chronological age, correlations were computed with height, sitting height, and weight. Between height and the total number of sounds, consonant blends, and consonant elements, when the age range was from two to six years, the correlations were significant and substantial; between height and vowels and diphthongs there was a slight positive relationship. When the age range included only one year, there was a tendency toward a slight negative relationship between height and total number of sounds, consonant elements, and consonant blends. With sitting height the correlations were practically the same as with height, but a trifle lower; when the age range was narrowed there was a tendency toward slight negative correlations at four and five years. Since sex differences in weight are usually found at these ages separate correlations were computed for boys and girls. The correlations for boys were practically the same as for height for both sexes; for girls slightly lower, except with total number of sounds, where the correlation was .72 ± .08. There were too few cases to permit correlation with weight for boys and girls at the separate age levels.

Two indices that are sometimes used for indicating nutritional status, the weight-height index and von Pirquet's peli-

[1]Marston, Leslie R.: The Emotions of Young Children: An Experimental Study of Introversion and Extroversion. Univ. Iowa Stud., Stud. in Child Welfare, 1925, 3, No. 3, pp. 99 (p. 87).

disi, were included.[2] The correlations with weight-height index were positive and for consonant elements and consonant blends substantial (.49 ± .05 and .37 ± .08); in this index the influence of age has been largely ruled out. The correlations of weight-height index and total number of sounds, vowels and diphthongs were positive, but barely three times their probable errors. The correlations with the pelidisi were insignificant and low, with a tendency toward negative relationship.

Correlations between speech sounds and two measures of motor ability, the perforation test[3] and the Wellman tracing path test (42), were computed. For the perforation test the correlations with the total number of sounds, consonant elements, and consonant blends were positive and significant, but with vowels and diphthongs they were only slightly larger than their probable errors. The correlation between the perforation test and chronological age for the thirty-four children was .71 ± .06. For the tracing path test the correlations with the total number of sounds and consonant blends were significant and fairly high (.67 ± .06 and .65 ± .06), but the other correlations were less than three times their probable errors (Table 17). The correlations between the tracing path scores and chronological age previously reported by Wellman (42, p. 32) were .81 ± .03 for boys and .82 ± .03 for girls.

In order to determine whether the number of older children in the family influenced the accuracy of production of sounds, correlations were computed with the number of older siblings. None of the correlations was significant, except with diphthongs at three years, where there was a slight negative correlation.

Individual Differences

In order to see whether children who were alike in speech were alike or different in other traits, thirteen pairs of chil-

[2]Pirquet, C. F., von: Sitzöhe und Körpergewicht. Ztsch. f. Kinderheil., 1916, 14, 211-228.
The formula for obtaining the pelidisi is:

$$\frac{\sqrt[3]{10 \times \text{weight in grams}}}{\text{Sitting height in centimeters}} = 100 \text{ per cent}$$

[3]Baldwin, Bird T., and Stecher, Lorle I.: The Psychology of the Preschool Child. New York: D. Appleton, 1925. pp. 305 (pp. 95-98).

dren were selected on the basis of similarity in production of speech sounds, and a comparison was made of their standing in eight other traits. As will be seen in Table 18, eight of the pairs were identical in number of consonant elements given correctly, five were identical in consonant blends, five in vowels, seven in diphthongs, and five in total number of sounds correct.

In chronological age the members of these pairs differed from 0 to 21 months. In mental age they differed from 2 to 35 months. In introversion-extroversion ratings they differed from 1 to 30 points; the total possible range in introversion-extroversion is 80 points. In height the pairs differed from

TABLE 18

Comparison of Eight Traits of Thirteen Pairs of Children Alike in Speech Sound

Index Number	Consonant Elements	Consonant Blends	Vowels	Diphthongs	Total Number of Sounds	Chronological Age, Months	Mental Age, Months	Introversion-Extroversion Rating	Height in Centimeters	Weight in Kilograms	Weight-Height Index	Sitting Height in Centimeters	Pelidisi
F276	25	1	7	2	35	24	29	74	85.0	11.9	.14	52.4	93.8
M263	24	1	6	2	33	25	27	70	90.2	12.3	.14	54.0	92.1
F303	21	5	8	3	37	27	29	77	90.2	13.9	.15	54.0	95.9
M257	21	6	8	2	37	39	40	81	102.2	15.6	.15	59.1	91.0
F315	54	41	9	4	108	37	44	63	93.6	16.0	.17	55.5	97.8
F268	54	41	10	3	108	48	47	54	103.5	15.8	.15	59.8	90.5
F253	60	46	10	4	120	48	53	76	99.8	15.6	.16	58.7	90.8
M298	60	45	11	4	120	65	71	79	110.4	20.4	.18	64.0	91.9
F253	60	46	10	4	120	48	53	76	99.8	15.6	.16	58.7	90.8
F234	60	47	9	4	120	66	88	66	113.1	17.7	.16	62.8	89.5
M297	55	33	11	4	103	50	57	77	102.8	19.2	.19	58.7	98.3
M310	55	34	11	3	103	61	70	51	109.2	20.7	.19	62.0	95.5
M262	49	33	9	4	96	51	57	52	103.8	17.7	.17	60.1	93.3
M261	48	32	9	4	93	59	63	49	112.0	19.5	.17	63.9	90.6
M265	57	47	10	3	117	57	64	68	108.5	16.7	.15	62.7	87.9
F183	57	47	11	4	119	62	82	60	111.5	17.2	.15	62.5	88.9
F296	48	37	8	3	96	57	63	68	110.6	17.4	.16	60.6	92.1
M304	47	37	9	2	95	36	36	82	101.2	17.8	.18	56.8	99.1
F270	59	45	11	4	117	61	82	60	110.5	19.3	.17	61.2	94.4
M259	59	45	11	4	119	61	66	50	106.4	17.6	.17	59.1	94.9
M275	58	46	9	4	117	61	65	64	105.0	18.8	.18	59.5	96.3
M285	58	45	10	3	116	64	72	67	111.1	20.5	.18	61.9	95.3
M285	58	45	10	3	116	64	55	67	111.1	20.5	.18	61.9	95.3
M265	57	47	10	3	117	57	64	68	108.5	16.7	.15	62.7	87.9
F260	61	46	11	4	122	68	80	75	105.0	16.3	.15	57.6	94.7
F253	60	46	10	4	120	48	53	76	99.8	15.6	.16	58.7	90.8
Odds													
Mean	51.1	36.1	9.5	3.5	100.3	50.1	56.2	70.5	102.0	16.8	.16	58.6	94.0
S.D.	12.6	14.9	1.2	.5	28.7	12.8	15.4	5.9	7.8	2.3	.01	5.7	2.9
Evens													
Mean	50.8	36.4	9.6	3.2	100.0	53.2	59.9	65.6	106.1	17.5	.16	60.6	92.1
S.D.	12.7	14.8	2.0	.8	29.1	11.0	17.5	4.6	6.3	2.3	.02	6.6	3.1

TABLE 19

Comparison of Speech Sounds and Six Other Traits of Twelve Pairs of Children Alike in Chronological Age and Mental Age

Index Number	Chronological Age, Months	Mental Age Months	Consonant Elements	Consonant Blends	Vowels	Diphthongs	Total Number of Sounds	Introversion-Extroversion Rating	Height in Centimeters	Weight in Kilograms	Weight-Height Index	Sitting Height in Centimeters	Pelidisi
F306	25.	25	17	0	9	2	28	76	86.6	13.1	.15	53.0	95.8
M263	25	27	24	1	6	2	33	70	90.2	12.3	.14	54.0	92.1
F250	34	41	38	8	10	3	59	63	93.8	16.9	.18	56.5	97.8
F278	34	48	49	28	10	4	91	68	96.6	15.5	.16	57.2	93.8
M299	37	41	43	32	10	2	87	61	92.4	15.6	.17	54.4	99.0
M254	37	42	36	12	7	3	58	83	95.0	13.9	.15	54.0	96.0
M316	39	36	54	34	6	2	96	61	99.4	14.4	.15	57.0	85.1
F252	40	43	53	35	11	4	103	47	97.8	14.6	.15	56.0	93.9
F218	40	40	54	43	9	4	110	66	91.6	13.0	.14	52.0	97.3
F284	40	46	31	15	5	3	54	81	101.2	16.2	.16	58.4	93.2
F252	40	43	53	35	11	4	103	47	97.8	14.6	.15	56.0	93.9
F313	40	37	51	29	9	4	93	62	92.8	13.2	.14	53.1	95.9
F253	48	53	60	46	10	4	120	76	99.8	15.6	.16	58.7	90.8
F159	48	53	54	42	8	4	108	77	102.4	16.7	.16	59.9	91.9
M297	51	57	55	33	11	4	103	77	102.8	19.2	.19	58.7	98.3
M262	51	57	49	33	10	4	96	52	103.8	17.7	.17	60.1	93.3
F296	57	63	48	37	8	3	96	68	110.6	17.4	.16	60.6	92.1
M265	57	64	57	47	10	3	117	76	108.5	16.7	.15	62.7	87.9
M322	58	65	46	44	9	2	101	69	107.8	19.6	.18	61.8	93.9
M267	58	68	51	41	9	4	105	66	111.0	20.6	.19	64.0	92.3
M251	59	64	56	43	11	4	114	75	102.1	18.3	.18	58.5	96.9
M261	59	63	48	32	9	4	93	49	112.0	19.5	.17	63.9	90.6
M275	61	65	58	46	9	4	117	64	105.0	18.8	.18	59.5	96.3
M259	61	66	59	45	11	4	119	50	106.4	17.6	.17	59.1	94.9
Odds													
Mean	45.7	49.4	43.5	33.4	9.4	3.2	89.7	66.9	99.1	16.4	.17	57.2	94.7
S.D.	11.1	12.9	11.4	14.1	1.4	1.2	25.4	8.3	6.8	2.2	.02	2.9	3.8
Evens													
Mean	45.5	46.8	46.8	30.0	8.7	3.6	89.2	65.1	101.5	16.1	.16	58.5	93.0
S.D.	11.1	10.3	10.4	14.7	1.8	.7	27.4	13.0	6.7	2.4	.01	3.6	7.5

2.6 to 13.3 cm.; a year's increase in height at these ages is roughly from 5.0 to 8.5 cm. In weight the pairs differed from .2 to 4.8 kg.; a year's increase in weight at these ages is approximately 1.3 to 2.1 kg. The weight-height indexes differed from 0 to .03. Sitting height differed from .2 to 5.3 cm.; a year's increase in sitting height is approximately 2.0 to 4.0 cm. In pelidisi the differences ranged from .5 to 7.4.

Twelve pairs of children who were alike in chronological age and mental age are compared in Table 19 in regard to speech sounds and six other traits. No pair varied more than ten days in chronological age and seven pairs varied less

than five days. In mental age two pairs were the same, four pairs varied one month, one pair two months, one pair three months, two pairs six months, and two pairs seven months.

In number of consonant elements given correctly these pairs differed from 1 to 23, in consonant blends from 0 to 28, in vowels from 0 to 6, in diphthongs from 0 to 2, and in total number of sounds from 2 to 56. In introversion-extroversion ratings they differed from 1 to 26 points. In height they differed from 1.0 to 9.9 cm., in weight from .2 to 3.2 kg., in weight-height index from 0 to .02, in sitting height from .4 to 5.4 cm. These pairs, selected on the basis of chronological age and mental age tended to be closer together in these physical growth traits than were the pairs selected on the basis of likeness in speech sounds. In pelidisi they varied from 1.1 to 8.8.

Summary and Conclusions

The development of preschool children's ability to produce correctly the sounds of the English language was studied. The investigation aimed primarily (1) to develop a technique for the study of the young child's ability to produce sounds, (2) to establish tentative norms, (3) to study age, sex, and individual differences, (4) to study the interrelations of abilities on the different sound groups and the relation of speech sound ability to other abilities and characteristics, and (5) to analyze errors.

The method used in the main investigation was the testing of the accuracy of sound production through presentation of pictures and recording in phonetic symbols words that children gave in response to questions regarding the pictures. The symbols of the International Phonetic Association, supplemented by dashes to indicate position of the sound in a word, were used. One hundred thirty-three sounds were tested, including sixty-six consonant elements, forty-eight consonant blends, fifteen vowels, and four diphthongs.

Two hundred four children from two to six years of age who were in daily attendance at the preschool psychological laboratories of the Iowa Child Welfare Research Station were tested. Their mean intelligence quotient was 115.9, with a

standard deviation of 15.4.

The reliability of the test, obtained by correlating the number of alternate sounds given correctly, was .96 ± .01 for children from two to six years of age. For alternate consonant elements the reliability was .77 ± .05 for thirty-four four-year-old children, and .80 ± .04 for thirty-six five-year-old children.

Significant age differences were found in the mean number of consonant elements and consonant blends given correctly. Significant differences were also found for vowels between two and five years and three and five years, and for diphthongs between two and four years and two and five years.

At three years of age 82.5 per cent of the diphthongs were given correctly, 75.2 per cent of the vowels, 68.4 per cent of the consonant elements, and 51.8 per cent of the consonant blends. At five years the percentages varied only from 87.2 to 90.0. There was an abrupt gain from two to three years, but further data are needed at the two year level to determine whether this gain will be substantiated.

There was wide variation in the difficulty of the different sounds as determined by the percentages of children giving correct responses. Between the easiest and most difficult consonant elements there was a difference of 84.1 per cent, between the consonant blends and vowels there were differences of 45.1 and 43.3 per cents respectively, while between diphthongs the widest variation was only 18.3 per cent.

Each consonant blend was given correctly by at least 20 per cent of the children at three years of age, each consonant element by 30 per cent, each vowel by 60 per cent, and each diphthong by 70 per cent. At five years of age each consonant element and consonant blend was given correctly by 40 per cent of the children, each vowel by 70 per cent, and each diphthong by 80 per cent.

The sounds that were given correctly by 90 to 100 per cent of the children who were completely tested on 123 sounds included sixteen consonant elements, *t–*, *p–*, *–b–*, *–m–*, *b–*, *m–*, *n–*, *–n–*, *f–*, *–p–*, *d–*, *h*, *w–*, *–g–*, *–k–*, and *–m*: no consonant blends; four vowels, *i*, *a*, ə, and *u*; and on,

diphthong, *ɔI*. The sounds that were given correctly by less than 50 per cent of the children included two consonant elements, *–θ*, and *–ð*; four consonant blends, *θr*, *nd*, *skr–*, and *lk*; no vowels, and no diphthongs.

Although consistent ranking of a sound through all age groups appeared to be the exception, the consonant elements tended to keep their relative rank at the various ages, as is indicated by the correlations ranging from .48 ± .07 to .81 ± .03 between percentages of children giving the sounds correctly. That there was less tendency for the consonant blends to keep their relative ranks is indicated by the correlations ranging from .14 ± .10 to .59 ± .06. The correlations were highest at the younger ages and between adjacent age groups.

Final sounds were more difficult than initial or medial sounds. Nasals were easier than stops and fricatives. Stops were easier than fricatives. No differences were found between voiced and voiceless consonants.

The girls tended to be superior to the boys on consonant elements. On vowels no definite conclusions as to the sex differences could be made from the data.

Of the four types of errors made, substitutions constituted the highest percentage on both consonant elements and consonant blends. A larger percentage of the errors on consonant blends than on consonant elements were substitutions. There was a tendency for the proportion of omissions to decrease with age and of inconsistencies to increase with age. On consonant blends there was also a tendency for the proportion of substitutions to decrease with age and for the proportion of approximations to increase with age.

A high relationship between age and the ability to give the sounds correctly is indicated by the correlation .80 ± .03. Between mental age (Stanford-Binet) and speech sounds the correlation was .71 ± .04. When mental age was held constant, the correlations between chronological age and the total number of sounds, consonant elements and consonant blends were still significant (.51 ± .07, .49 ± .07, and .31 ± .06), but when chronological age was held constant no relationship was found between mental age and speech sounds, except for a very slight relationship with diphthongs (.24 ± .08).

No relationship was found between speech sounds and introversion-extroversion ratings, size of vocabulary, or number of older children in the family.

When the age range was one year no relationship was found between speech sounds and height or sitting height. Between weight-height index and consonant elements and consonant blends there were substantial correlations (.49 ± .05 and .37 ± .08). Between the pelidisi and speech sounds the correlations were insignificant and low, with a tendency toward negative relationship.

A substantial relationship was found between the tracing path test of motor control and the total number of speech sounds correct and consonant blends correct (.67 ± .06 and .65 ± .06) when the age range was two to six years. Definite correlations were also obtained between the perforation test and total number of sounds correct, consonant elements correct, and consonant blends correct (.52 ± .09, .53 ± .09, .40 ± .11). Since both the tracing path and perforation tests are highly correlated with age, it is possible that the relationships between these tests and speech ability would be considerably reduced when determined within a narrower age range.

Pairs of children of the same sex who were similar in production of speech sounds were found to differ considerably in chronological age, mental age, introversion-extroversion ratings, height, weight, sitting height, and pelidisi. Pairs of children selected on similarity in chronological and mental age were found to differ considerably in the number of speech sounds given correctly. These latter pairs tended to be closer together in the physical growth traits than were the pairs selected on the basis of likeness in speech sounds.

The investigation indicates the need for the study of additional cases at the two year level and of younger children, particularly in regard to vowels and diphthongs, since so large a proportion of these sounds was given correctly by the youngest children included. Repeated testing of the same children over a period of years would throw light on many of the problems raised. Some mechanical means of recording the child's responses would be desirable, particularly as

a check on the efficacy of the examiner and for permanency of record. Supplementing the test through a study of additional words in the vocabularies of the children that contain the desired sounds would enable a more complete check on all sounds.

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